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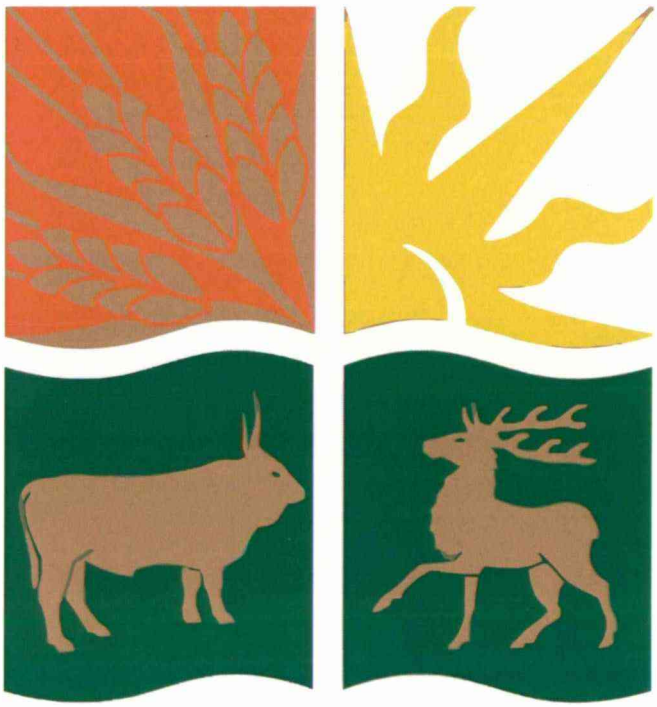

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PREFORMED DEFENSE RESPONSES IN A POWDERY MILDEW-RESISTANT HUNGARIAN CHERRY PEPPER CULTIVAR

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ABSTRACT
A Hungarian cherry pepper (*Capsicum annuum* var. *cerasiforme*) cultivar ('Szentesi') displays resistance to pepper powdery mildew caused by *Leveillula taurica*. Resistance also develops in susceptible sweet pepper (*C. annuum*) when grafted on resistant cherry pepper cv. Szentesi rootstocks. Powdery mildew (PM) resistance is correlated with high levels of the defense regulator reactive oxygen species superoxide ($O_2^{\cdot-}$) even in healthy plants. In order to further elucidate the mechanisms of preformed defense responses in cherry pepper cv. Szentesi we have monitored levels of salicylic acid (SA), a key molecule of plant defense signaling and expression of so-called pathogenesis/defense related (PR) genes in healthy pepper plants. Assays of free and bound (glycosylated) SA by high performance liquid chromatography (HPLC) revealed that in leaves of PM-resistant pepper levels of free SA are ca. twice as high compared to that of PM-sensitive plants. No difference occurred in levels of bound (glycosylated) SA. Expression of the *CaPR-1* gene was several times higher in leaves of PM-resistant pepper than in sensitive plants as assayed by real time reverse transcription quantitative polymerase chain reaction (real time RT-qPCR). On the other hand, high expression levels of the *CaPR-2* (glucanase) gene did not entirely correlate with PM-resistance, being detectable only in PM-resistant cv. Szentesi plants but neither in PM-resistant sweet pepper cv. Totál grafted on cv. Szentesi rootstocks nor in susceptible controls (cv. Totál). It seems that graft-transmissible PM-resistance of the cherry pepper cv. Szentesi is correlated not only with high levels of superoxide but also with elevated levels of free salicylic acid and enhanced expression of the defense-related *CaPR-1* gene.

Keywords: cherry pepper, powdery mildew resistance, salicylic acid, pathogenesis-related genes

INTRODUCTION

The endoparasitic powdery mildew fungus *Leveillula taurica* (anamorph: *Oidiopsis taurica*) is a serious threat to pepper and tomato production. Under a temperate climate, heavy epidemics may cause a significant yield loss of up to 2-4 kg/m^2 in greenhouse pepper production even though mildew symptoms develop only on leaves (CERKAUSKAS AND BUONASSISI, 2003). In Hungary, pepper powdery mildew is present since 1972, causing economic losses primarily in greenhouse production (forcing) of pepper (GLITS AND FOLK, 2000). Besides extensive fungicide applications, pepper powdery mildew can be controlled by using resistant cultivars containing R genes introgressed from related wild species but this race/cultivar specific resistance is often overcome by newly emerging pathogen races (see e.g. ZHENG ET AL., 2013).
A Hungarian cherry pepper (*Capsicum annuum var. cerasiforme* L.) cultivar ('Szentesi') bred from selections of wild-grown Mexican genotypes is highly resistant to pepper powdery mildew and has been used in production for over several years (see e.g. in LANTOS, 2011). Our previous experiments have shown that cv. Szentesi exhibits a symptomless resistance to powdery mildew infection and displays high levels of the reactive oxygen species superoxide ($O_2^{\cdot-}$), a key factor of plant disease resistance, even in healthy leaves. Both superoxide accumulation and resistance can be transmitted to

susceptible sweet pepper cultivars by grafting (KIRÁLY ET AL., 2013; KÜNSTLER ET AL., 2013). Superoxide has been shown to be associated with the establishment of plant resistance to various pathogens (DOKE, 1983; DOKE AND OHASHI, 1988; ÁDÁM ET AL., 1989). Superoxide can be converted to hydrogen-peroxide (H_2O_2) that induces the accumulation of salicylic acid, a key molecule of plant defense signaling, and expression of so-called pathogenesis (defense) related genes, processes which ultimately lead to plant defense responses and resistance to pathogenic infections (WARD ET AL., 1991; CHEN ET AL., 1993; TORRES ET AL., 2006; LEHMANN ET AL., 2015).

In order to further elucidate the mechanisms of preformed defense responses in the powdery mildew (PM) resistant cherry pepper cv. Szentesi we have monitored levels of free and bound (glycosylated) salicylic acid, and expression of so-called pathogenesis/defense related (PR) genes in healthy pepper plants. Our results suggest that high levels of salicylic acid and elevated expression of PR genes in cherry pepper cv. Szentesi may have a role in its symptomless resistance response to powdery mildew.

MATERIAL AND METHOD

Seeds of cherry pepper (*Capsicum annuum* var. *cerasiforme*) cv. Szentesi and sweet pepper (*C. annuum*) cv. Totál are commercially available in Hungary and were sown in a laboratory greenhouse. Grafts were carried out by cutting both rootstock and scion plants above the cotyledons in a 45° angle and pairing with the aid of a grafting clips. At least two weeks were allowed for development of graft unions. Plants were about 70 days old when used for experiments.

The presence of free and bound (glycosylated) forms of SA in healthy pepper leaves was detected by high performance liquid chromatography (HPLC) analysis as described by MEUWLY AND MÉTRAUX (1993) and COLE ET AL. (2004).

To assay expression of pathogenesis/defense related (PR) genes in healthy pepper leaves total RNA was extracted in liquid nitrogen with a plant RNA extraction minicolumn kit followed by reverse transcription and real-time quantitative polymerase chain reaction (qPCR) as described earlier (HAFEZ ET AL., 2012). Expression of a pepper actin gene (*CaAct*, GenBank accession AY572427) was used as an internal control.

Oligonucleotide primers used in qPCR were the following: 5'-ATCCCTCCACCTCTTCACTCTC-3' (5' primer) and 5'-GCCTTAACCATTCCTGTTCCATTATC-3' (3' primer) for a 128 bp pepper actin *(CaAct)* cDNA fragment (GenBank AY572427); 5'-GTTGTGCTAGGGTTCGGTGT-3' (5' primer) and 5'- CAAGCAATTATTTAAACGATCCA-3' (3' primer) for a 301 bp pepper PR gene *(CaPR-1)* cDNA fragment (GenBank AF053343); 5'-ACAGGCACATCTTCACTTACC-3' (5' primer) and 5'-CGAGCAAAGGCGAATTTATCC-3' (3' primer) for a 226 bp pepper PR glucanase *(CaPR-2)* cDNA fragment (GenBank AF227953).

RESULTS

HPLC assays of free and bound (glycosylated) salicylic acid (SA) in healthy pepper leaves demonstrated that in leaves of PM-resistant pepper (i.e. cv. Szentesi and sweet pepper cv. Totál grafted on cv. Szentesi rootstocks) levels of free SA are ca. twice as high as in PM-sensitive plants (*Fig. 1A*). However, no difference occurred in levels of the bound (glycosylated) form of SA: it was essentially the same in both PM-resistant and PM-susceptible pepper (*Fig. 1B*).

Monitoring transcriptional changes of so-called pathogenesis/defense related (PR) genes in healthy pepper leaves by real time RT-qPCR revealed that expression of the *CaPR-1* gene is several times higher in leaves of PM-resistant pepper than in sensitive plants. Interestingly, however, *CaPR-1* expression was by far the highest in PM-resistant cv. Szentesi plants, while it was markedly lower in PM-resistant sweet pepper cv. Totál grafted on cv. Szentesi rootstocks (*Fig. 2A*). On the other hand, high expression levels of the *CaPR-2* (glucanase) gene did not entirely correlate with PM-resistance, being detectable only in PM-resistant cv. Szentesi plants but neither in PM-resistant sweet pepper cv. Totál grafted on cv. Szentesi rootstocks nor in susceptible controls (cv. Totál) (*Fig. 2B*).

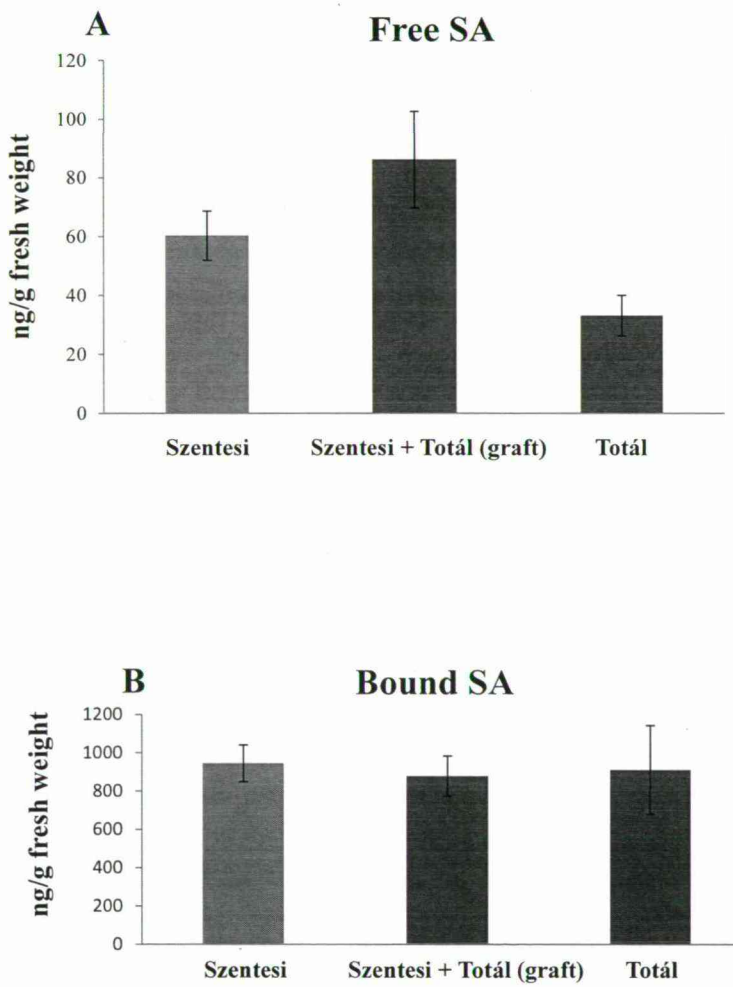

Figure 1. Levels of free (A) and bound (glycosylated) (B) salicylic acid (SA) in leaves of healthy pepper plants assayed by HPLC in powdery mildew-resistant cherry pepper cv. Szentesi and sweet pepper cv. Totál grafted on cv. Szentesi rootstocks and in powdery mildew-susceptible sweet pepper cv. Totál

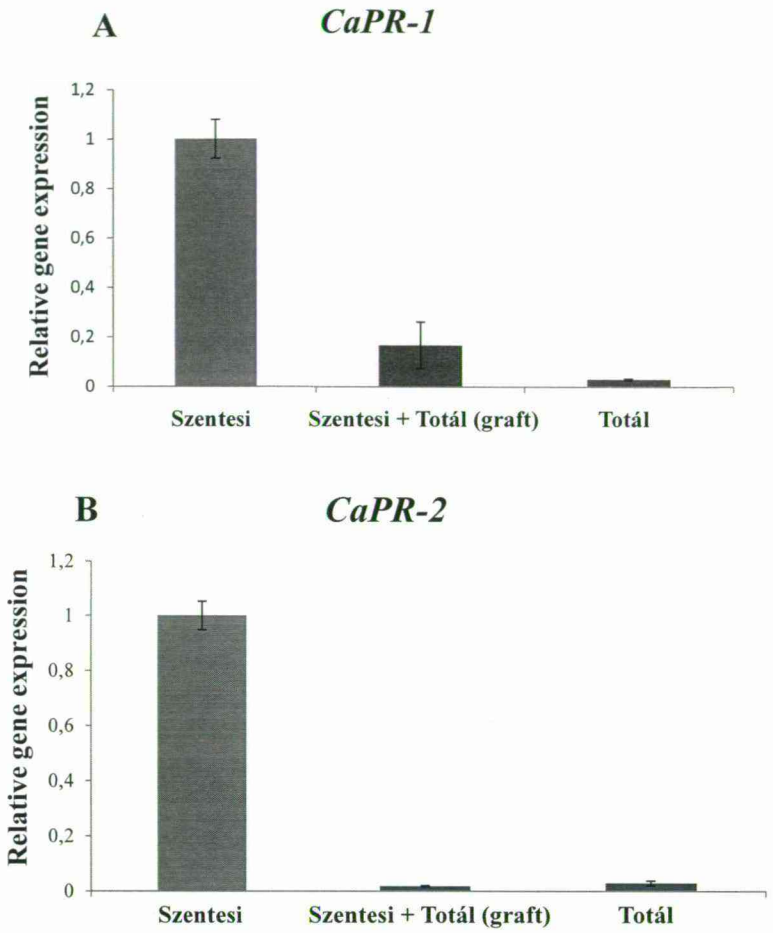

Figure 2. Expression of the pathogenesis/defense related genes *CaPR-1* (A) and *CaPR-2* (glucanase) (B) in leaves of healthy pepper plants assayed by real time RT-qPCR in powdery mildew-resistant cherry pepper cv. Szentesi and sweet pepper cv. Totál grafted on cv. Szentesi rootstocks and in powdery mildew-susceptible sweet pepper cv. Totál

DISCUSSION

Grafting may facilitate stable transmission of certain genotypic and phenotypic traits (RAPD DNA profiles, fruit shape and color) from e.g. pepper rootstocks to scions (see e.g. TALLER ET AL., 1998). However, only a few cases are mentioned in the literature when plant disease resistance has been transferred by grafting (ŠUTIĆ, 1965; AL-MAWAALI ET AL., 2012; VULIĆ ET AL., 2013), but the biochemical/genetic mechanisms were not described in any case. Our previous research has shown that resistance to pepper powdery mildew (PM) also develops in susceptible sweet pepper (*C. annuum*) when grafted on resistant cherry pepper cv. Szentesi rootstocks. This graft-transmissible PM resistance is correlated with high levels of the defense regulator reactive oxygen species superoxide ($O_2^{\cdot-}$) even in healthy plants (KIRÁLY ET AL., 2013; KÜNSTLER ET AL., 2013). It is known that in barley leaves artificial generation of superoxide by external treatment with e.g. riboflavin and methionine confers resistance to powdery mildew (*Blumeria graminis* f.sp. *hordei*) (EL-

ZAHABY ET AL., 2004). Also, sufficient expression of a NADPH-oxidase gene responsible for superoxide production is required for penetration resistance of barley to its powdery mildew pathogen (PROELS ET AL., 2010).

Results of our present study show that mechanisms of preformed defense responses in the powdery mildew (PM) resistant cherry pepper cv. Szentesi could involve not only the elevated production of ROS like superoxide but also elevated levels of the free form of salicylic acid (SA), a key molecule of plant defense signaling. Levels of free SA were ca. twice as high in leaves of PM-resistant pepper as in PM-sensitive plants. Evidence for the role of SA in plant resistance responses has come from experiments with transgenic tobacco and *Arabidopsis thaliana* unable to synthesize or accumulate high levels of SA (GAFFNEY ET AL., 1993; DELANEY ET AL., 1994; WILDERMUTH ET AL., 2001). Also, overproduction of SA in transgenic and interspecific hybrid plants stimulates resistance to viral and fungal pathogens (VERBERNE ET AL., 2000; COLE ET AL., 2004).

We found, however, that no difference occurred in levels of the bound (glycosylated) form of SA, it was essentially the same in both PM-resistant and PM-susceptible pepper. This suggests that bound forms of SA may not play a direct role in defense (disease resistance) responses of pepper plants. However, one should consider that the bound (glycosylated) form of SA (SAG) is how this signaling molecule is likely stored in plants, and hydrolysis of SAG in tobacco, a close relative of pepper, may require as little as 2 hours (HENNIG ET AL., 1993; VLOT ET AL., 2009). Therefore, *in planta* SAG might have a role in conferring basal levels of preformed defense responses in e.g. cherry pepper as well.

Our results also show that elevated expression of so-called pathogenesis/defense related (PR) genes in healthy cherry pepper cv. Szentesi may be associated with the preformed defense responses leading to PM resistance. Expression of the *CaPR-1* gene was several times higher in healthy leaves of PM-resistant pepper than in sensitive plants. *CaPR-1* is encoding for a basic PR-1 protein and shows elevated expression in pepper cultivars during successful resistance to the oomycete pathogen *Phytophthora capsici* (SILVAR ET AL., 2008). Similarly, overexpression of *CaPR-1* in tobacco plants enhances tolerance to oomycete and bacterial pathogens (SAROWAR ET AL., 2005). *PR-1* genes may also contribute to penetration resistance of barley plants to powdery mildew (*B. graminis* f.sp. *hordei*) infection, as shown by transient silencing of the *PR1-b* gene in barley epidermal cells (SCHULTHEISS ET AL., 2003). Although the functional role of PR-1 proteins in plant disease resistance is not exactly known, it has been demonstrated that in leaves of broad bean (*Vicia faba*) a basic PR-1 protein can inhibit differentiation of rust (*Uromyces fabae*) infection hyphae (RAUSCHER ET AL., 1999). In pepper, the basic PR-1 protein encoded by *CaPR-1* could play a similar role in PM-resistance, considering that both pathogens (broad bean rust and pepper PM) enter plant leaves through stomatal pores.

On the other hand, we have shown in this study that in healthy pepper leaves high expression levels of the *CaPR-2* gene do not entirely correlate with PM-resistance, being detectable only in PM-resistant cv. Szentesi plants but neither in PM-resistant sweet pepper cv. Totál grafted on cv. Szentesi rootstocks nor in susceptible controls (cv. Totál). *CaPR-2* encodes for a basic β-1,3-glucanase, an enzyme that hydrolyzes β-1,3-glucans, components of fungal and oomycete pathogen cell walls (see e.g. VAN LOON ET AL., 2006). Interestingly, *CaPR-2* expression is markedly induced after *P. capsici* infection only in certain resistant pepper cultivars and a significant gene induction is also observed during successful pathogenesis (SILVAR ET AL., 2008). It seems that *CaPR-2* expression may be involved not only in disease resistance but also in general stress responses during e.g. fungal pathogenesis, therefore, it is likely not a reliable marker of (preformed) plant defense responses.

In summary, the present study has demonstrated that graft-transmissible PM-resistance of the cherry pepper cv. Szentesi is correlated not only with high levels of superoxide but also with elevated levels of free salicylic acid and enhanced expression of the defense-related *CaPR-1* gene. These findings could serve as a basis for further investigations on elucidating the precise pathophysiological mechanisms of this symptomless resistance of pepper to its devastating powdery mildew pathogen.

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CHARACTERIZATION OF ROMANIAN AGRICULTURAL HOLDINGS

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ABSTRACT
Agricultural holding constitute it self as a form of organization, existent and in operation of the production process from agriculture. Organization and operation of agricultural holdings can be realized under various forms, from the easiest way - family farms, to private companies, family businesses and even private agricultural societies in case of companies with state capital (public etc.). The changes that occurred in Romania postdecembrieste agriculture are based on Law 18/1991, law which determined mainly changes regarding the land ownership, meaning its transfer into private ownership and acquisition by the former owners of property rights on earth. Application of land reform from 1991 and re allotment of Romanian peasants has as effect the increased fragmentation of agricultural land. So, the existence and functioning of a land market involves, primarily, the establishment of some farms profitable, of larger size, with a high degree of profitability and witch to allow all at once obtaining some competitive agricultural products with those of European countries.
Keywords: agricultural land, farms, subsistence farms, commercial farms

INTRODUCTION

Efficient use, from economic point of view of the main source of production, the land found, constitutes in a market economy, the base of a functional land market, which, allows landowners to organize themselves in performant farms and their optimum sizing.
In the process of economic development of EU member states with medium incomes, the main adjustments brought to the agricultural sector aimed, in particular, the investments in small farms modernization, less competitive and development of these, in order to transform them into commercial farms, which to allow increasing of incomes for farmers.

MATERIAL AND METHOD

In order to realize this study we used, besides specialized literature and data's provided by the Ministry of Agriculture, the Statistical Yearbooks of I.N.S and Structural Survey in Agriculture and also the data's provided by European Yearbooks (Eurostat). Scientific research methods used were: the binom induction and deduction and comparative analysis, used in comparing specific indicators of agricultural holdings, in different periods of time or in the same time period in Romania and the EU.

RESULTS

Romania has large areas of arable land with good quality soils. Natural conditions and environment gives to Romania great possibilities for development of a sustainable and performant agriculture, however, land fragmentation due to changing of ownership forms, lack of investments in farms modernization and backwardness regarding the agricultural policies do not allow efficient use of production resources and, mainly, of the land resources. (BRAD, 2015)

The application of the Land Law no. 18 of 1991 has made as private propriety on agricultural land to be dominant. The analysis by type of ownership of agricultural land shows that the most part of the lands are in private, individual or public propriety. So, until now, 95% from the agricultural land is in privat propriety. (IANCU, 2007)
The main types of farms that have constituted after the application of the land laws are: individual farms, family associations, agricultural companies, commercial agricultural companies. (FEHER, 2009)
Individual farms, agricultural companies with legal personality and family associations form the private sector of agriculture. Together they use 95% from the agricultural surface of the country. The most part of the utilized agricultural area is exploited in individual households (65.2%) and large units with legal personality exploits 34.8% from UAS.
After implementation the Land Law, Romania has faced and still faces with a high degree of fragmentation of agricultural land. *(Table 1.)*

Table 1. The situation of agricultural holdings

Indicators	Holdings - total			Agricultutal hodings without legal status			Agricultutal hodings with legal status		
	2002	2010	2013	2002	2010	2013	2002	2010	2013
Numer of holdings (thousands)	4485	3859	3630	4462	3828	3602	23	31	28
Agricultural area in use (thousands ha)	13931	13306	13056	7709	7450	7271	6222	5856	5785
- arable (thousands hectares)	8774	8306	8198	5437	4725	4558	3337	3581	3640
- pastures and hayfields (thousands ha)	4644	4506	4398	1878	2307	2315	2766	2199	2083
- permanent crops (thousands ha)	344	312	302	225	236	240	119	76	62
- gardens (thousands ha)	169	182	158	169	182	158	-	-	-
Average agricultural area in use (ha)	3.11	3.45	3.60	1.73	1.95	2.02	274.43	190.78	207.49

Source: INS

The analysis of agricultural holdings by legal status highlights a high percentage of the farms, without legal personality (individual households).
In the period 2002-2013, at national level it may be seen a reduction of the number of agricultural holdings (-19.06%), the main cause being the merging of lands and increasing the average size by farm, from 3.11 ha/holding in the year 2002, to 3.45 ha/holding in the year 2011 and 3.6 ha/holding in the year 2013.
Agricultural holdings, without legal personality, 99.23% from the total number of existing agricultural holdings at national level, in the year 2013, exploit the largest agricultural area, 55.69%, with an average of 2.02 ha/holding. Compared to the year 2002, the number of such type of agricultural holdings was reduced with 19.27%. Regarding the total agricultural area, used, it was decreased with 438,000 ha, while the average size of holdings increased from 1.73 ha/holding to 2.02 ha/holding.
So, from the 3,602 thousand individual agricultural holdings witch have a utilized agricultural area of 7.27 million ha, 89.9% have a surface less than 5 ha, the production obtained being entirely destined for own consumption. Over 98% from these are mixed holdings both for crop production and livestock, a classification of them by area or by the number of animals being not conclusive.
In Romanian agriculture, agricultural holdings with legal personality, hold a very small share, 0.77%, exploiting an area of 5.785 million ha (44.31%) from useful agricultural surface at national level. Even if these types of holdings are found in small number, the

average size of such holding is very high compared to the ones without legal personality 207.49 ha/holding, in the year 2013. Although during the period 2002-2013 there has been a decrease of the average size of agricultural holdings with legal personality, compared to the year 2010, it can be seen an increase of this indicator.

It notices the small share of associative forms of only 7.02% from the total utilized agricultural area, such as the lack of associative forms for marketing agricultural products, such as producer groups or agricultural cooperatives.

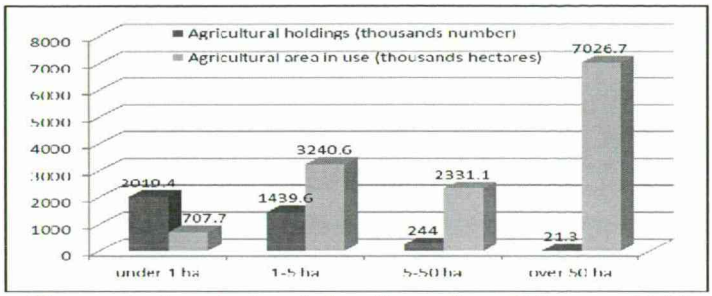

Figure 1. Analysis of the class size of farms, 2010

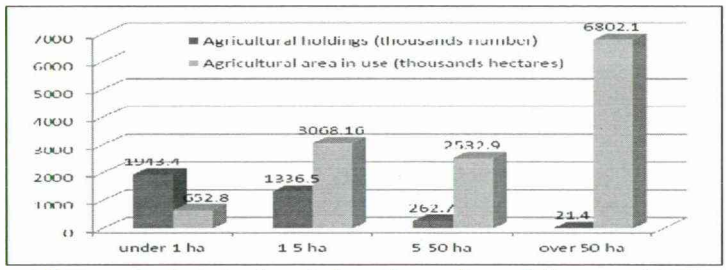

Figure 2. Analysis of the class size of farms, 2013

The analysis by class sizes of agricultural holdings, comparative in the year 2010 (*Figure 1*) and 2013 (*Figure 2*) highlights the following aspects: (BRAD ET ALL., 2015)

- agricultural holdings less than 1 ha, decreased from 2.019 million holdings, in 2010 to 1.9434 million holdings in 2013;
- agricultural holdings of size class 1-5 ha, in the year 2010, have also experienced a decrease, of 7.16% from 1.439 million holdings, to 1.336 million holdings in 2013;
- agricultural holdings from the category under 1 ha and those from 1-5 ha size category, exploits together in the year 2010, 3.948 million hectares, meaning 29.67% from the total of useful agricultural area (USA), while in the year 2013, operates a smaller area, 3.694 million hectares, meaning 28.5%;
- the other two size classes 5-50 and over 50 ha, represents in the year 2010, 7.12% and exploit together, 9.358 million ha (70.32%) while at the level of the year 2013 represents 7.97% and exploits 71.5% from useful agricultural area.

Comparing the situation of agricultural holdings from Romania with the one from EU, during the period 2002-2013, it can be drawn the following conclusions: (STANCIU, 2013)

- Romania holds the largest number of agricultural holdings from EU (3.63 million agricultural holdings);
- 28.69% from total number of agricultural holdings existent at the level of EU can be found in our country;
- The average size of an agricultural holding in Romania is in the year 2013, much lower (3.60 ha) compared to the EU average (11.7 ha);
- The average size of an agricultural holding in Romania, from the year 2002 in the year 2010 has increased slightly, from 3.11 to 3.60 ha;

Defining the small farms as having a surface of 5 ha, they represented, in 2013, 92.3% from total of Romanian agricultural holdings and worked 23.55% from the utilized agricultural area (subsistence farms with dimensions less than two hectares representing 71% from total holdings and operating 13% from utilized agricultural area, from which holdings under one hectare occupied 5.0% from utilized agricultural area).

Table 2. The share of small farms (after the criteria and thresholds most used) in the total number of agricultural holdings in 2007, EU (%)

	Agricultural area in use (UAA)		Market participation	Economic doimension (ESU)		
	< 2 ha	< 5 ha	More than 50% selfconsuming	< 1 ESU	< 4 ESU	< 8 ESU
Bulgaria	87	95	70	76	96	98
Czech Republic	34	50	31	34	63	72
Slovakia	76	87	93	77	93	95
Estonia	13	36	46	45	82	89
Poland	44	68	38	53	80	90
Latvia	17	41	72	59	90	95
Lithuania	14	61	54	63	92	96
Hungary	82	89	93	83	78	95
Romania	65	90	81	78	98	99
France	13	25	-	7	21	29
Germany	7	23	-	6	25	38
UK	28	40	-	40	56	64

Source: DGA Agri, Rural Development in the EU - Statistical and economic information - 2011

Considering the economic limit 8 ESU in order to define all small farms (subsistence and semi-subsistence), these comprise 99% from agricultural holdings of Romania, 98% from those from Bulgaria, 96% from those of Lithuania, respectively 95% from those of Latvia and Hungary (*Table 2*).

Such a distribution accentuated bipolar, with most part of agricultural land divided, on the one hand, between holdings extremely modest in physical and economic size, which produce mainly for own needs, do not invest and do not generate consume on the market, and on the other hand, a relatively small number of farms that produce in industrial system and adopt modern technologies, constitutes the main factor witch limits the increasing of the competitiveness of Romanian agriculture. The duality of Romanian agricultural sector is one of the greatest challenges of policy makers, maintaining despite of some measures meant to lead to lands consolidation and inter-sectorial reallocation of labor force.

The classification of Romanian farm having on base the economic size, may constitute as base, witch to allow the adaptation of Romanian agriculture to European Union requirements in the period 2014-2020, thus creating premises for taking decisions regarding the programming and using the Community funds.

The accession to the European Union has brought profound changes regarding the orientation of rural development and agriculture, by the principles of the Common Agricultural Policy (CAP), having as main objective, increasing the productivity, the development of rural areas by improving the living standards, ensuring the quality of food products and food security, the competitiveness of agricultural and food markets and prices stability.

Since the moment of accession, through its programs of support of the agriculture, the European Union has tried to encourage the attraction of funds for development and modernization of Romanian agriculture in general and of the agricultural holdings in particular.

The strategy of European Union 2020 regarding rural development aims that, fin the futurethe economic growth to be based on knowledge and innovation, sustainable and inclusive. So, for the period 2014-2020 EU rural development policy follows three main objectives: the competitiveness of agriculture; sustainable management of natural resources; balanced territorial development of rural areas. (RAICOV ET ALL., 2013)
In present, in Romania, through the Rural Development Programm its try reducing the existing gap at national level, concerning agricultural holdings. So, funding programs aim specifically: agricultural holdings of small and medium size, and those with disfavoring conditions, encourage and support of the young farmers, creating of the new medium-sized holdings, organization of small farmers in the marketing structures of production, etc. The fact that the great latifundias own lands in lease and concession, and thus the ownership over the land is maintained by the rural population, can be a base to improve the situation. (GHERMAN ET ALL., 2013)
The merge of agricultural lands remains a priority in the action of the development of agriculture and modernization of agricultural holdings. Next, *Figure no. 3*, we present the structure of agricultural holdings, by size classes, eligible SAPS, in the year 2013. (IANCU, 2013)

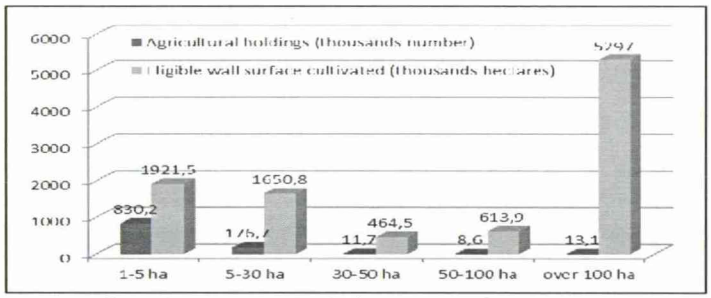

Figure 3. Structure of agricultural holdings, by size classes, eligible SAPS, 2013

According to data's from the Agency for Payments and Intervention in Agriculture (APIA), in the year 2013, are eligible a number of 1.040 million farms, but only 29.19% from the total of holdings existent at national level. Agricultural area eligible for SAPS funding is 9.948 million hectares, 76.19% from the utilized agricultural area in this year. The average of size per holding in APIA subsidizing is 9.56 ha/holding. (FEHER ET ALL., 2013)
The presence, still, in large number of small farms, in parallel with large farms, indicates a very pronounced structural imbalance that affects Romanian agriculture and its competitiveness.

CONCLUSIONS

The current state of Romanian agricultural holdings, the presence in large number of small holdings, does not allow the practice of modern agriculture and achieving of high productions, competitive on domestic and European market and at the same time the ensurance of some decent incomes for farmers. In this respect, it imposes the conversion of small holdings, mainly of peasant households in family farms with commercial character, modern, which can effectively use the production resources (natural, human and technological) existent or, who can be attracted through agricultural support programs offered by the European Union.
Achieving these goals requires actions and measures of agricultural policy interrelated between them and sustainable in time:

- encouraging and supporting the increasing of dimension and economic size of agricultural holdings;
- stimulation of farmers in attracting European funds for the development of farms as well as for strengthening their own financing sources;
- development of associative and cooperation forms in order to increase the concentration degree of agricultural production and of the possibilities of it capitalization;
- increasing the productivity of labor and of the incomes of farmers;
- a better information on the future agricultural policy, mainly on the posibilities to support small-scale farms;
- encouraging farmers to invest in private infrastructure projects: storage, cooling, packing, etc., and development of some processing activities of the products obtained, of the development of short chains interposed between producers and consumers, thereby facilitating the instalation of young farmers, creating new jobs and encouraging younger generations to get involved in agriculture sector;
- stimulation of employment in rural area and of the entrepreneurship spirit;

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THE IMPACT OF SOIL AND CLIMATIC FACTORS ON FOREST GROWTH

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ABSTRACT
This preliminary study reveals the relations between the forest growth (annual dendromass increment; ADM_{inc} – as dependent variable) and some important soil factors, which have effect on plant growth, such as: groundwater level (GWL), groundwater composition (GWC), plant available water capacity (PAWC), depth of humus layer, texture (hy_1) and pH of the soil, moreover the maximum concentration (MAX) of salt and $CaCO_3$ and the depth of its MAX in the soil profile. 17 plantations (Poplar, Common oak and Black locust) are included in the analysis investigated all over the Great Hungarian Plain. Correlation profile of the above parameters was created explaining that two abiotic parameters limit plant growth: if GWL is deeper than 5 m and if HCO_3 concentration in groundwater is high (above 15 meq/L). Within the tested range (0.17 – 2.23 mS/cm for electrical conductivity (EC) and 0.5 /sand/ - 4.21 /clay loam/ for hy_1), the higher magnitude of EC results in higher ADM_{inc} and the higher hy_1 (higher proportion of fine soil particles) leads to higher ADM_{inc}. The positive relationship of ADM_{inc} with EC suggests good nutrient supply of the soil, while the higher proportion of fine particles refers to better water management properties. Thickness of humus layer is an important soil factor: compared to shallow humus layer, deep one increases ADM_{inc} exponentially. In case of Black locust, PAWC is the substantial factor for growing, unlike Poplar, whose growth depends on groundwater uptake (GWU). This phenomenon originates from the differences between the individual needs of the tree species and differences in root morphology.
Merely 4 sampling plots were equipped with meteorological stations, thus the number of climatic parameter data were not enough for statistical analysis. So data for all 17 plots were collected from literature and a general, regionally calculated data were applied (mean rainfall in the vegetation period and aridity index). There was no significant correlation between climatic parameters and ADM_{inc}.
Further studies and more field investigations are needed in order to clarify the results.

Keywords: dendromass production, groundwater level and composition, soil factors

INTRODUCTION

The aim of this preliminary study is to reveal the factors influencing tree growth (dendromass production) in planted Poplar (*Populus* × *canadensis*), Common oak (*Quercus robur*) and Black locust (*Robinia pseudoacacia*) forests of Hungary. 70 plantations were investigated all over the Great Hungarian Plain. Out of them, 17 forests were re-examined a few years later to get information about the growth of the plantation. Soil and groundwater chemical and physical data, moreover biotic and climatic data are included in our database, used for statistical analysis.
According to our hypothesis, dendromass production is influenced by the parameters below:

- groundwater level (GWL) (compared to the depth of active water uptake zone of the roots) (TÜFEKCIOGLU ET AL., 2005; VAN SLYCKEN AND VEREECKEN, 1990),
- groundwater chemical composition (GWC),
- plant available water capacity (PAWC) of the soil (BERGANTE ET AL., 2010),

- depth of humus layer in the given soil (type),
- pH of the soil (availability of the elements) (DI BENE ET AL., 2011; GUO AND HAN, 2008; TÜFEKCIOGLU ET AL., 2005),
- maximum concentration (MAX) of salt and $CaCO_3$, and the depth of MAX in the soil profile (compared to the depth of root zone) (CARTER, 1981; EVERS ET AL, 1997),
- texture of the soil in the root zone (hyl) (DECKMYN ET AL., 2004; TÜFEKCIOGLU ET AL., 2005),
- mean rainfall in the vegetation period (BERGANTE ET AL., 2010, MICHELOT ET AL., 2012),
- aridity index (drought) (DECKMYN ET AL., 2004, DÖVÉNYI, 2010, KUSTER ET AL., 2013, ZANG ET AL., 2012).

MATERIAL AND METHOD

The sampling sites were selected based on the categories of geologic maps of surface sediments and soils (KUTI ET AL. 1981, 1982, 1984, 1986), considering water table level, salinity and soil texture. In addition, databases of tree plantations describing forest tree species (Poplar, Common oak, Black locust) and stand age were used (TÓTH ET AL. 2001). The 70 investigated forests were surveyed between 2012 July and 2014 August, and 17 of them was re-examined in 2015 September. Out of these 17 forests, 11 were supplied with groundwater monitoring equipment. The groundwater pressure sensors were measuring water table level in every 15 minutes and have stored measured data. 4 meteorological stations were set up in the control stands (nearby croplands and grasslands), which also recorded air temperature, relative humidity, solar radiation and the amount of rainfall every 15 minutes.

To avoid edge effect, boreholes for soil sampling were located at least 50 m away from the border of the plantation. The maximum depth of the boreholes was 11 m as limited by the augering equipment. Soil sampling was done to the depth of groundwater table + 1 meter. The samples were taken at every 20 cm increment from the topsoil to 1 m and at every 50 cm increment below 1 m.

Water samples were taken in every case, when water table level was <10 m with hand vacuum pump. Samples were stored at cool conditions until laboratory analysis. Field pH and electrical conductivity (EC) measurement was performed on every water sample.

In forest stands, biomass assessment, consisting of tree height measurement and stem circumference at the height of 130 cm was carried out. Dendromass (m^3/ha) was calculated from the above data for all the three tree species.

Active water uptake zone of the roots was identified based on the location of the maximums of Cl^- and EC in the soil. Namely, during water uptake from groundwater, salts and chloride (as an inert element) are excluded by the roots and accumulated in a defined soil layer, which is parallel with water uptake zone. If there were huge differences between the depth of the two maximums, Cl maximum was the decisive, because EC maximum could be determined by a large number of other variables beside salt content.

Groundwater uptake (GWU) was calculated based on the method of NOSETTO ET AL. (2007). Calculation was performed on the basis of the difference of total soil chloride content of the plantation and control grassland down to the bottom of root zone, and the groundwater chloride concentration below the root zone, considering the age of plantation.

Statistical analysis was carried out with SPSS 11.5. Spearman's rank correlation was applied due to the distribution of the data. Linear regression (LR), linear discriminant

analysis (LDA) and analysis of variance (ANOVA) was carried out for modeling the relationship between the variables and for explaining the influencing factors on the dependent variable, the tree growth.

RESULTS

Results of statistical analysis performed based on our hypothesis are presented hereinafter. There was no significant correlation between tree growth (annual dendromass increment: ADM_{inc}; [m^3/ha/year]) and the groundwater level (GWL; [m]) compared to the depth of active water uptake zone of the roots. Although it was stated, that GWL (above 5 m depth) have significant (p=0.074) and strong negative (r_{Sp}=-0.71) correlation with ADM_{inc} (N=7). This means that shallower water table causes greater increase in ADM_{inc}, and 5 m is the limit for forests on the Great Plain to get water from groundwater for optimal growth. Two main field parameters were applied to calculate ADM_{inc} for each tree type: tree height and diameter. According to the relevant literature (for poplar), there is a definite correlation between the height growth and the relative position of the water table in the soil (TÜFEKCIOGLU, 2005; PRUITT, 1947). Positive correlation - can be revealed between these parameters - is valid only down to a certain optimum depth (a few decimeters, according to tree types) (PRUITT, 1947). Beneath this optimum depth, growth of trees is inversely correlated with groundwater depth (7 to 23 m; R^2 = 0.69, P = 0.025; GRIES ET AL, 2003). According to additional results of MAHONEY AND ROOD (1992), tree height decreased with increasing rates of water table decline. These results are in agreement with ours.
Analyzing the relations between the ADM_{inc} and PAWC, it was found that out of the three investigated tree species, the strongest correlation (r_{Sp}=0.54) was found between the growth of Black locust and the PAWC of the soil (*Figure 1*). This relationship was stronger, than that of for all forest types (*Figure 1*). There were just a few data available for the oak forests, thus the analysis can't be done. Growth of the poplar is not depending on the PAWC of the soil, there is no significant correlation between them. It strongly (r_{Sp}=0.85, p=0.004, N=9) depend on the GWU, instead. Vigor of growth of different tree species is reflected in the slope of the linear regression (*Figure 1*: 9.92 – poplar > 5.82 – black locust, oak cannot be evaluated).

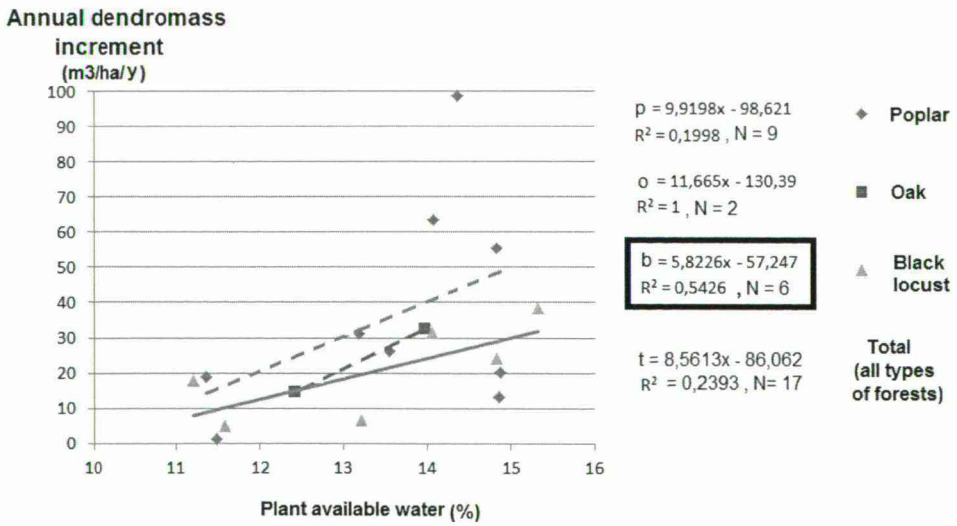

Figure 1. The effect of PAWC (%) on ADM_{inc} (m^3/ha/year)
(Dashed lines represent weak coefficient of determination or insufficient data number.)

TÜFEKCIOGLU (2005) also did not find significant correlation between PAWC and poplar growth in Turkey. In contrast, Bergante et al. (2010) carried out a study on young (irrigated) poplar plantations (in the first 2 years of short rotation coppices) in Po valley, and found that water availability was the main variable driving biomass production. In this case, the difference between the results can be commented by the fact, that the roots of young poplar trees are not developed enough to reach groundwater, so it is forced to uptake moisture from the unsaturated soil (PAWC).

Among anions, ADM_{inc} depends on the concentration of HCO_3^- in the groundwater ($gwHCO_3$) according to the following equation:

$$ADM_{inc} = 64.129 - 2.721 * gwHCO_3$$

(applying one-way ANOVA).

ADM_{inc} is inhibited by the high level (>15 meq/l) of HCO_3^- in groundwater (r_{Sp} =-0.48, p=0.098, N=13). In case of cations, there is no relationship with ADM_{inc}.

Relationship between the thickness of the humus layer and ADM_{inc} is significant (p=0.055) but not strong (r_{Sp}=0.223). If the soil has deep humus layer, ADM_{inc} increases exponentially (*Figure 2A*). Significant (p=0.055), but not too strong (r_{Sp}=0.473) correlation can be discovered between the genetic type of soil and humus layer thickness, as well (*Figure 2B*). Among the investigated soil types only MSC, MCS and HSS can be evaluated due to the low number of samples from the other soil types (abbreviations explained in *Figure 2* legend). MSC has the deepest humus layer (*Figure 2B*), and parallel helps to reach the highest ADM_{inc}. HSS has the shallowest humus layer resulting in the smallest increase in ADM_{inc} (*Figure 2B and C*). BIDLÓ (2014) stated that tree growth is defined mostly by the humus layer and physical characteristic of the soil (Zala County, Hungary). Large differences were found in the growth of beech stands on soils with different thickness of humus layers, but this relationship was linear.

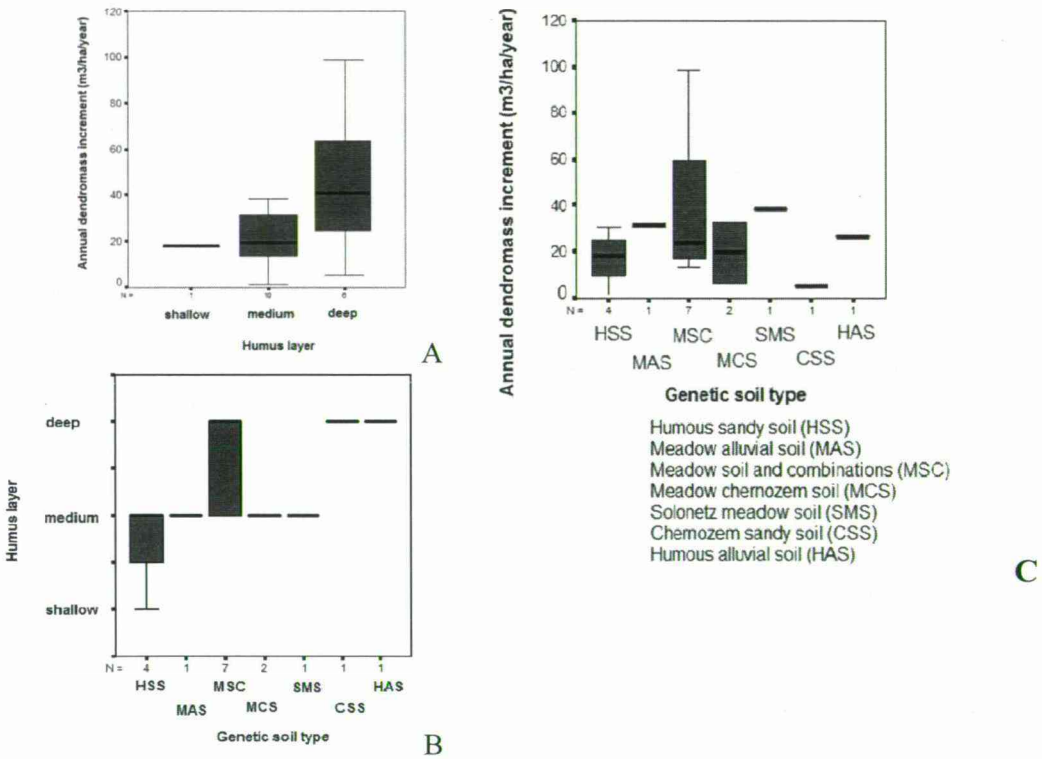

Figure 2. Distribution of the ADM_{inc} and thickness of the humus layer (A), ADM_{inc} and genetic soil type (B), thickness of the humus layer and genetic soil type (C) represented by boxplot

There is no direct correlation between soil pH and ADM_{inc}, but $gwHCO_3$ is connected to both, unsaturated (r_{Sp}=0.652, p=0.016, N=13) and saturated soil pH (r_{Sp}=0.725, p=0.005, N=13) significantly.

Electrical conductivity (EC) of soil is generally understood to be the total water-soluble salt content (TSC) of the soil that involves both useful and harmful salts of nutrients - relevant to the plant nutrition - in an electrically conductive mixture. The soils that are well supplied with nutrients have higher TSC, than the weakly supplied ones. Besides, EC value is influenced by moisture content and texture of the soil.

The statistical analysis showed that a significant (p=0.021), moderately strong, positive (r_{Sp}=0.682, N=11) relationship have disclosed between the extent of EC maximum in unsaturated soil and ADM_{inc}. This may be due to EC range measured in the soil during the investigation is moderate: 0.17 – 2.23 mS/cm, which equals to ~136-1784 mg/l TSC. This range is lower than the tolerance limit of the studied trees and coincides with the EC values of soils with beneficial nutrient supply for plants (1-2 mS/cm). Thus, available nutrient supply of these soils known to be good and promotes optimal growth.

EVERS ET AL. (1997) investigated poplar sooths growth under NaCl stress (300 mmol/l) and stated that after 28 days, both the shoot and root growth decreased compared to control. According to TÜFEKCIOGLU (2005), Mg^{2+} content of the soil showed a significantly negative correlation with the growth of poplar. Thus both Na- and Mg-salts in soil expose inhibitory effect on tree growth if being in high quantities. SHANNON ET AL (1999) stated that waste water, having high TSC – used as irrigation water in sandy soil environment (Riverside, CA, USA) - reduced growth of poplars. But all of these studies were carried out under higher salt concentrations, than our investigation.

There is no relationship between $CaCO_3$ and ADM_{inc}. DOUINEAU (1942) promoted phrase "percent active lime content" that means the $CaCO_3$ content in the clay+fine silt fraction of the soil, indirectly responsible for plant growth reductions and physiological disorders. CARTER (1981) stated that in poplar plantations on Chernozemic soils, active $CaCO_3$ exceeding 7-9 % causes stunted growth of the plantation. In our case, mean $CaCO_3$ of the soils is 8.2 % in the whole profile, so only a small part of this value can be found in the fine fraction, which has no influence on tree growth.

Both the depth of EC and $CaCO_3$ maximum has no correlation with ADM_{inc}, neither in their absolute value, nor in relation to the depth of the root zone.

Tree roots are located in its largest number and weight in the unsaturated zone of the soil (2,5-5,5 m according to PHILLIPS ET AL., 2014). There is significant (p=0.017) and moderate to strong positive relationship (r_{Sp}=0.651, N=17) between the texture of unsaturated zone in the soil (hyl) and ADM_{inc}. It means that the higher fine particles of soils (loam and clay) the higher growth of trees. In line with our results, DECKMYN et al. (2004) stated in short rotation coppices, that poplar growth was strongly reduced (from 12,4 t/ha/year to 6 t/ha/year) on sandy soils, due to severe drought stress can occur. In contrast, TÜFEKCIOGLU (2005) stated that sand content of the soil had a positive correlation with the growth of poplar due to improved soil aeration, and clay content showed a significantly negative correlation with that, due to high clay content may have high water-holding capacities but inadequate aeration. His experiments were performed on clayey soils with high fine soil particle content (mean clay+silt: 78.6%), whereas on our sample areas, soil texture was mainly sandy loam with the mean of 1.92 hyl ~ 30 % fine soil particles, which explains the difference between the results. BERGANTE ET AL. (2010) draws attention to the fact that soil texture and organic matter content may interact with plant growth by influencing soil structure and hydrological characteristics.

Our database includes few elements to clearly evince correlations between mean rainfall in the vegetation period and ADM_{inc}, or between aridity index (DÖVÉNYI, 2010) and ADM_{inc}.

For proving the context of climatic parameters and ADM_{inc}, further investigation is needed on other sampling plots. In the above mentioned study of BERGANTE ET AL. (2010), no correlation was found between production and annual mean temperature in young poplar plantations. According to DECKMYN ET AL. (2004), drought reduces poplar growth on all soils types during summer.

CONCLUSIONS

The results indicate that soil conditions have a strong influence on the growth of forests within the Great Hungarian Plain. Result of the study is shown as a correlation profile (*Figure 3*), which summarizes soil parameters affecting the growth of forests.

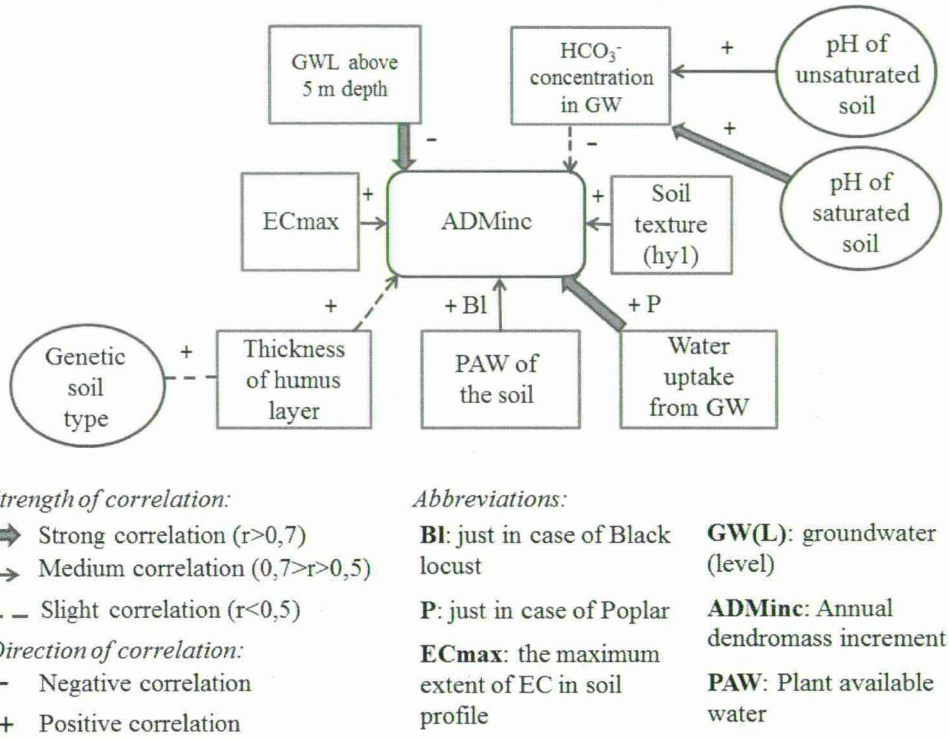

Figure 3. Correlation profile of the ADM_{inc} influencing parameters. Exclusively significant correlations are presented. r: Spearman type correlation coefficient

Knowledge of the relationship between soil features and tree growth is necessary for further cost-benefit analysis and land evaluation. Results can help us to understand the limits of each soil parameters, that would be fulfill to have a productive plantation in the Great Hungarian Plain. In order to get a similar correlation model for the relation of climatic parameters and tree growth, more sample sites have to be studied for a longer period.

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THE EFFECT OF FERTILIZER TO THE BIOGENIC AMINES CONCENTRATION IN WINES

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ABSTRACT
In the last few years food compounds which have a physiological effect (especially wine compounds) came to the front, therefore biogenic animes have gained on importance. In our experiment we determined - for oenological conditions important - histamine, tyramine and serotonin content with HPLC technique. Biogenic amines are produced from amino-acids (precursors) during the decarboxylation procedure. Commercial fertilizers and combinations were independent factors, and biogenic amine concentrations were observed as dependent factors (the Cserszegi fűszeres samples, vintage 2015, were homogenous form in every aspects except the fertilizer usage under alcoholic fermentation=AF). After AF - thus after various fertilizer additions - considerable changes were shown in the amount of the investigated three compounds, although we could not find an obvious pattern. Histamine and tyramine were far away from the toxic limit, serotonin presence was slightly higher than in the earlier results, however serotonin is not a poisonous compound (positive evaluation), hence the ascent was not a problem.

Keywords: fertilizer, biogenic amine, histamine, tyramine, serotonin

INTRODUCTION

Nowadays healthy food - in our case healthy wine- came to the front (in public and scientific context as well). (In our opinion 'healthy' is not a fortunate term, because food strictly cannot be 'unhealthy', like cigarette smoke or mind-altering drugs.) Obviously some foods - also some wines - have higher rate of valuable components, of course these foods can contain compounds from natural origin which have allergenic or other physiological effect. The present experiment is focusing on the biogenic amine content of wine, which is produced during the metabolic activity of microorganisms. In our case the decarboxylation of amino acids is one of the most important way of producing. In relation to other fermented foods the biogenic amine content of wines is low. From oenological aspect important amines are histamine (HIS, toxic limit: 2-10 mg/l), tyramine (TYR, toxic limit: 1-10 mg/l) and serotonin (SER, typical level: 7-10 mg/l) (NAILA ET AL., 2010). Earlier works have been studied the biogenic amine content of various white and red wines, significant differences have been found, together with the influence of the year and the grape variety, these factors did not have main role in biogenic amine level (KÁLLAY and NYITRAINÉ ET AL., 2003; *Table 1*).
Fertilizer usage ensures, together with natural amino acid presence, the required level of yeast assimilable nitrogen (YAN) under AF, these compounds are the precursors of biogenic amines, consequently the HIS, TYR and SER level are influenced.

Table 1. Biogenic amine composition of Hungarian Wines

Biogenic amine	White wine (mg/dm^3)	Red wine (mg/dm^3)
Cadaverin	NQ-0,3	NQ-0,69
Ethyl-amine	NQ-0,4	NQ-0,8
Histamine	0,17-1,25	0,59-2,2
Methyl-amine	0,21-1,30	0,3-0,87
B-phenyl-ethyl-amine	NQ	NQ-0,78
Putrescin	0,31-1,78	0,45-5,49
Serotonin	NQ-0,75	NQ-1,07
Tyramine	0,1-1,1	0,3-0,95
Tryptamine	ND	ND

Source: Kállay- Nyitrainé, 2006

In our present work the amount of the three biogenic amines were measured, and the base analysis were done, so the effect of the fertilizers and combinations were shown up to the biogenic amines and base parameters.
HIS is poisonous over 500 ppm, the poisoning manifests itself as an allergen-type reaction characterized by in allergic reaction, difficulty in breathing, itching, rash, vomiting, fever, and hypertension. The toxic effect of HIS is enhanced, when other biogenic amines are present (synergic relation). The process of HIS forming is called histidine decarboxylation (PRETI ET AL., 2016).
Tyramine stem from tiramin decarboxylation, TYR is reported to be the initiator of dietary-induced migraine and hypertensive crisis, similarly other aromatic biogenic amines. The acute toxicity is 2000 ppm, NOAEL (no observed adverse effect level) is also 2000 ppm (NAILA ET AL., 2010).
SER is an important tryptophan derivative, which has a role in human regulation system of mood, appetite, sleep and temperature. The low level of SER generate migraine, depression and tinnitus. SER (5-HT) in this form cannot get over the blood-brain barrier, however its precursors TPH and 5-HTP can do so, which means they have a physiologic effect (BERGER ET AL., 2009).

MATERIAL AND METHOD

Sample preparation

The samples (vintage: 2015, grape variety: Cserszegi fűszeres) were treated in the course of AF with various type and dose of fertilizers, then we used basic- and fit for purpose analytical measurements. Parameters of must and new wine treatments (our aim were a production of an average white wine): must sulfiting (10 g/q Potassium-bisulfit), enzymatic treatment (1,5 g/q), must clarification (10 °C, 24h), yeast starter (20g/hl), together with the experimental fertilizer dosage under AF. In our work we studied five commercial products, in various combination (*Table 2*). These materials differed from each other (effect/ purpose of dosage): whereas DAP® is an inorganic nitrogen- source, Viniliqiud® and Bioferm® are inactivated and partially/fully autolyzed yeast (organic N- source). Springarom® is not

autolyzed inactive yeast, it has two function not only N-source, but also significant reducer agent, so protect the wine from oxidation, while Springcell® is a yeast hull (cell wall) product, which has detoxification potential, furthermore it helps the yeast survive in the course of AF, but did not change the YAN.
Our samples were homogenous form in every aspects except the fertilizer usage under AF, so independent factor was the effect of fertilizer, while dependent factor was biogenic amine concentration.

Table 2. Fertilizers and combinations

No.	Fertilizer combination	Abbrev.	Quantity (g/hl. or ml/hl)
1	Bioferm®	BD	3x20=60
	DAP®		3x20=60
2	Viniliqiud®	V	50+10=60
3	Bioferm®		3x20=60
	DAP®	BDSc	3x20=60
	Springcell®		1x20=20
4	Viniliqiud®	VSc	50+10=60
	Springcell®		1x20=20
5	Bioferm®		3x20=60
	DAP®	BDSa	3x20=60
	Springarom®		1x30=30
6	Viniliqiud®	VSa	50+10=60
	Springarom®		1x30=30

Method of analysis

- Free- and total sulphurous acid concentration, titrimerty (OIV-MA-AS323-04A)
- Titrable acidity (OIV-MA-AS313-01)
- pH (OIV-MA-AS313-15).
- Ethyl-alcohol concentration (OIV-MA-AS312-01A 4.C.)
- Sugar concentration (OIV-MA-AS2-02)
- Volatile acidity (OIV-MA-AS313-02:R2009)
- Glycerol concentration (OIV-MA-AS312-05: R2009)
- Folin-Ciocalteu index- polyphenol concentration (OIV-MA-AS2-10)
- Chromatic Characteristics (OIV-MA-AS2-07B)
- Biogenic amine concentration, HIS, TYR, SER, HPLC technique (OIV-MA-AS315-18)

Chromatographic conditions:
Type of equipment: HPLC typed HP 1050. Column: Nukleosil C-18 200 * 0. Detector: Fluorescent detector, HP 1046 type. Liquid-flow: 10 ml/min. Temperature: 30 °C
λ_{ex} : 340 nm λ_{em}: 440 nm
Composition of eluent: A – solution: 0.08 M acetic acid, B – solution: Acetonitrile HPLC-qualified.
The efficiency of the reversed phase chromatographic segregation was enhanced with gradient elution technics.

RESULTS

The new wine samples were after AF dry every time, their alcohol content depended on the sugar concentration of the must (about 12-14v/v%), this level was uplifted a bit above the normal level. The titrable acidity and pH were appropriate, so with the currently adequate SO_2 level, thus the samples are defended from oxidation or undesirable activity of presence microorganisms (if this levels will reduce in the future SO_2 completion will be necessary). The volatile acids were on a normal level (about 0,3-0,4 g/l), the total polyphenol concentration was slightly higher than in usual white wines. The investigated base-parameters met the requirements, we obtained our purpose, the normal, average white wine, which was suited for the analysis of the biogenic amine concentration beside various fertilizer combinations.

The description of the biogenic amines

The investigated biogenic amine concentration did not reach the critical level (HIS and TYR toxic limit) and we found significant differences between a pair of samples, but did not find observable obvious trend. The samples HIS concentration was in the lower half of the ordinary interval, and only 1,5 mg/l maximum difference appeared, but statistically it was 50% ascent. The amount of TYR were shown normal level, the values were far away from the toxic limit, in one sample TYR was significant lower than the others, wich can mean VSa is a promising combination (*Figure 1*).

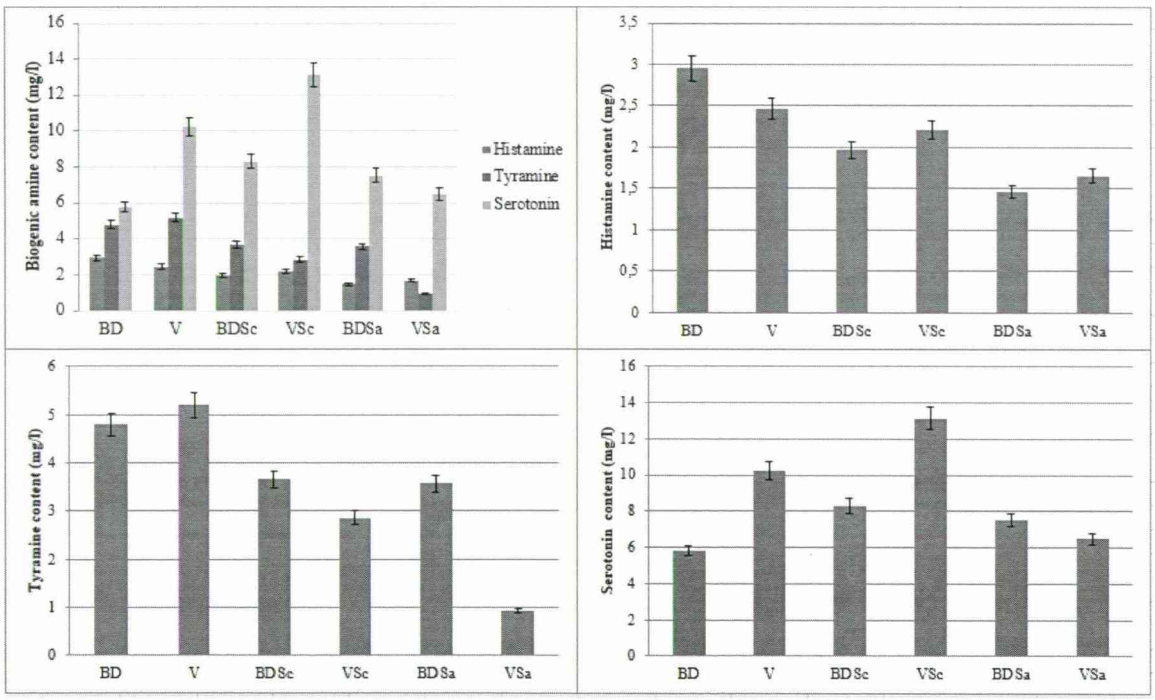

Figure 1. The biogenic amine content by various fertilizer combinations

In case of SER we could speak about typical level, SER concentration was in our samples slightly higher than in the earlier results, but it was not a problem, on the whole presence of SER was desirable. We found significant differences in the biogenic amine concentration of the samples. The BD combination eventuated higher HIS and TYR- and lower SER level in these experimental conditions. Every three measured biogenic amines got into the upper part of the present interval, when we used the V fertilizer. The BSc

combination was shown up as the mean of the investigated fertilizer combinations. The VSc combination seemed to the most effective dose, not only HIS and SER were average, but also SER level was by far the best. The BDSa combination effected lower level in case of all the three biogenic amines. The TYR concentration was on the minimum, the other two amines were average by the usage of VSa combination.

CONCLUSIONS

In these experimental conditions the applied fertilizers and combinations did not make unwholesome/negativ change in the amount of the investigated biogenic amines. About the fertilizers, correlated to each other, we can establish the following statements:

- The use of Viniliquid shifted the concentration of all the three component to positive direction (except one sample).
- The Bioferm, DAP combination was the less successful in itself from the aspect of biogenic amines, however the addition of the third fertilizer (Springcell or Spring arom) in every case yielded advantageous changes (lower HIS and TYR and higher SER concentration).
- The use of Springcell generated diffrent results, because with BD combination the biogenic amine content decreased, but with V fertilizer we measured higher amount of SER and lower amount of HIS and TYR (this was the desired option).
- The concentration of biogenic amines were decreased uniformly by Springarom.

All in all the use of the investigated feritlizers did not make negative change in biogenic amine content, I would go further than that: several combinations had advantageous effect (for example VSc). The variability in the concentrations are explained on the one hand with the incomparable processes of fermentation (two same fermentaition never existed, because the amount of metabolits were controlled- one by one- by the yeast, the purpose of the whole system was the balance), on the other hand the fertilizers were not homogenous, for that reason it was not possible to show wich compound(s) was responsible for the changes in biogenic amine content.

At the same time from a practical point of view our experiment proved that the conscious usage of fertilizers could influence the level of valuable/underirable compounds in wine.

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APPLICABILITY OF LASER DIFFRACTION ANALYSES IN SOIL PHYSICS PRACTICE

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ABSTRACT
In this research we present the first results how can be used laser diffraction measurement in soil physics practice. The main goals are understanding differences of particle size distribution (PSD) measurments, developing converting methods of PSD data of different determinations. In order to realization of this survey a representative soil database of Hungarian soil types was built up. We compared PSDs of 157 soil samples measured with sieve-pipette method (SPM) and laser diffractometer technique (Malvern Mastersizer 2000) (LDM). Soil textural classes were also determined using the USDA texture triangle.
We used the clay/silt fraction boundary values (clay < 0.0066 mm; silt: 0.0066 – 0.05 mm) introduced for the LDM data in order to take them comparable to PSD data determined by the SPM: We got higher similarities of clay and silt fractions of the modified size boundary values. For the used dataset correspondence of texture classes derived from SPM and LDM PSD data, however is not higher than 60%.
Keywords: soil, particle size distribution, laser diffraction, pipette method

INTRODUCTION

Particle size distribution (PSD) is one of the main soil physical properties. It determines many other characteristics, such as water retention, hydraulic conductivity, pore size distribution, aggregate stability, Atterberg limits, microbial activity, as well (e.g. WÖSTEN ET AL., 2001; LAMORSKI ET AL., 2014).
Measuring the sand, silt and clay fractions can be done by different methods, like sieving (mainly sand size particles), sedimentation (with hydrometer or pipette methods), or with laser diffractometer method (LDM) (KONERT AND VANDENBERGHE, 1997; RYŻAK AND BIEGANOWSKI, 2010; LAMORKSI ET AL., 2014). LDM is becoming more often used in soil science, but its application has not yet replaced the labour-intensive pipette or hydrometer procedures. In PSD determining methods different pre-treatments are used for removing the cementing and flocculating agents – such as calcium carbonate, organic matter, iron oxides. Different pre-treatments may produce different PSD data (RYŻAK AND BIEGANOWSKI, 2010; MAKÓ ET AL., 2014a,b). Different PSD standards use different particle size limit (NEMES ET AL., 1999) which can also cause diverse results (KONERT AND VANDENBERGHE, 1997; NEMES AND RAWLS, 2006). LDM usually measures (under-estimates) smaller clay fraction values than the conventional methods (KONERT AND VANDENBERGHE, 1997; POLAKOWSKI ET AL., 2014).
There are intentions all around the world to harmonize the PSD data by the LDM measurements to that of the sedimentation techniques (pipette or hydrometer methods). Unfortunately, up to the applied methodology (e. g. type of pre-treatments, kind of dispersant etc.), PSDs of the sedimentation methods (due to different standards) are dissimilar and could be hardly harmonized with each other, as well. A need was arisen

therefore to build up a database, containing PSD values measured by the pipette method according to the Hungarian standard (MSZ-08. 0205: 1978) (henceforward SPM) and the LDM according to a widespread and widely used procedure.
In this publication we compared the PSD of 157 soil samples measured by SPM and LDM.

MATERIAL AND METHOD

The 157 soil samples originated from different layers of 53 soil profiles, collected in Tokaj Region, North-Hungary in 2014 and 2015 (*Fig. 1*). Samples are mainly from forest soils.

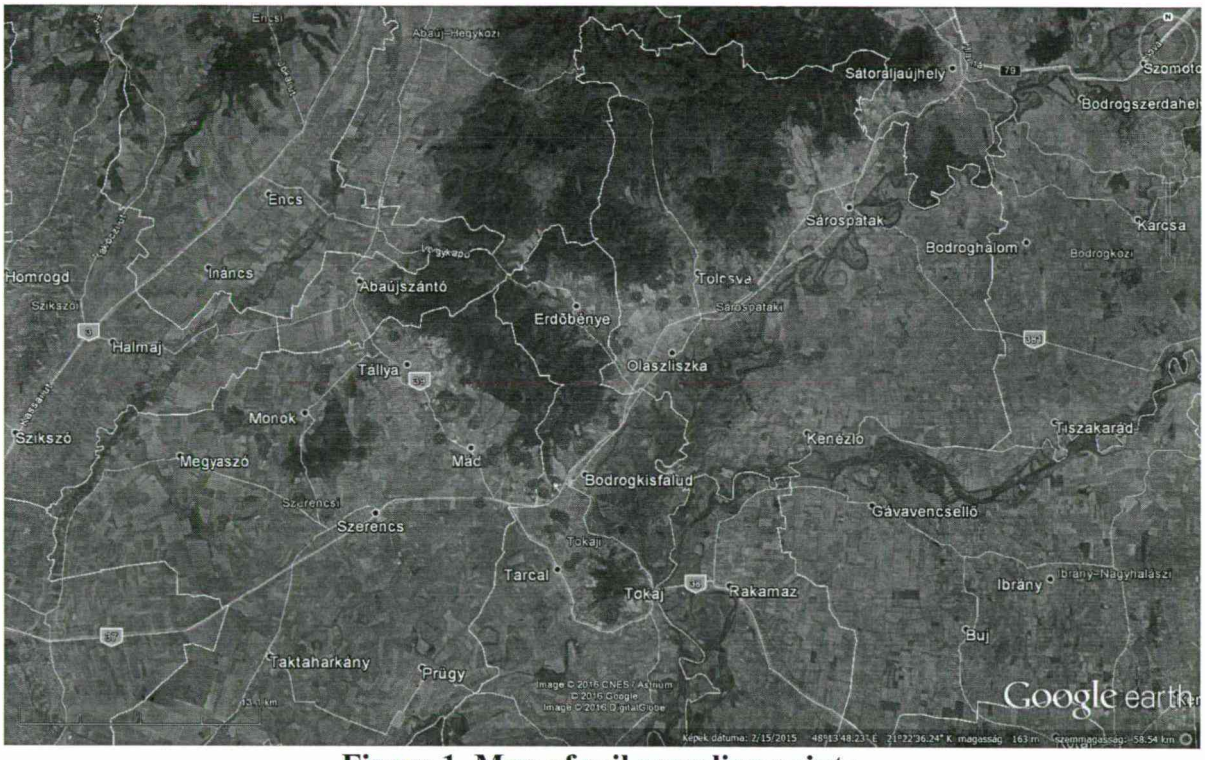

Figure 1. Map of soil sampling points

Particle size distribution measurements with SPM were carried out. Coarse sand particles were separated by 0.25 mm sieve. Sodium pyrophosphate solution was used as dispersing agent.
PSD measurements with LDM were carried out by Mastersizer 2000 (Malvern Ltd), in Hydro 2000G dispersion unit at least two repetition, with the following settings: rotation speed: 700 rpm; ultrasonic: 75%, 4 minutes; dispersant solution: 33 g sodium-hexametaphosphate + 7 g sodium-bicarbonate/L; absorption index: 0.1; refractive index: 1.52.
Based on previous experiences (on the grounds of Hungarian and European soil databases (MAKÓ ET AL., 2014b; BARNA ET AL., 2015)) and results of KONERT AND VANDENBERGHE (1997), we modified the size limits of clay and silt fractions measured by the LDM *(Table 1)*. Clay fraction is counted under 0.0066 mm, silt fraction ranges between 0.0066 and 0.05 mm.

Table 1. Size limits of particle-size fractions (mm)

	clay	*silt*	*sand*
SPM	<0.002	0.002 – 0.05	0.05 – 2
LDM_original	<0.002	0.002 – 0.05	0.05 – 2
LDM_modified	<0.0066	0.0066 – 0.05	0.05 – 2

From the measured sand, silt and clay fractions, either with the modified size limits, soil texture was determined according to USDA texture triangle. Texture classes were compared: in how many cases match the pipette method and the LDM.

RESULTS

The results of 325 particle size distribution (PSD) measurements were compared (*Figure 2–4)*. In *Figure 2* the comparison of clay fraction is shown measured by the pipette method and the LDM, and characterised with different particle size limits (*Table 1*). In case of modified particle-size limits a little bit stronger correlation was found between pipette method and LDM. The modified particle-size limits resulted in a much smaller underestimation of clay fraction.

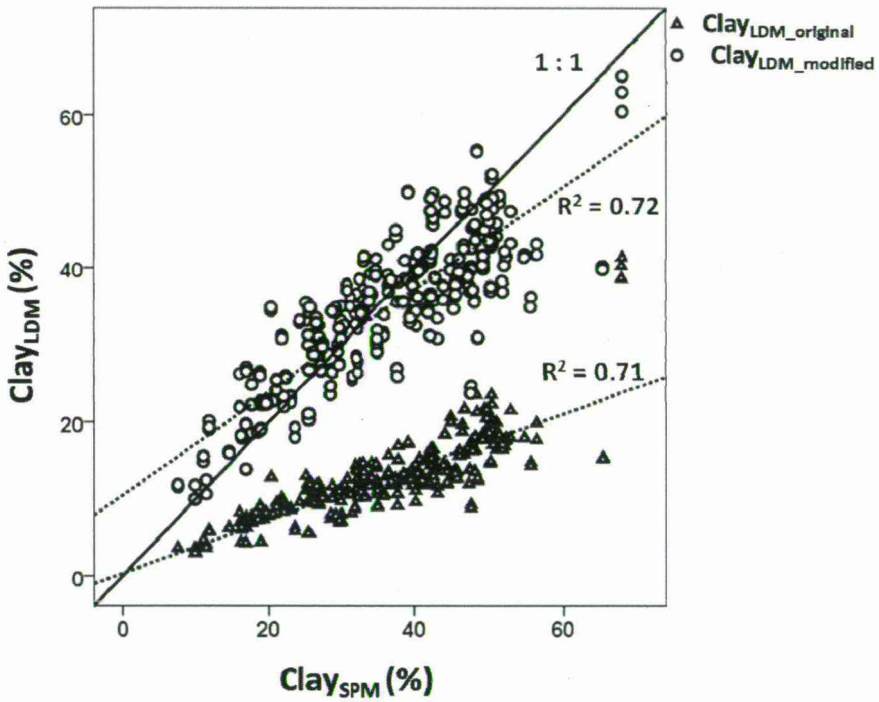

Figure 2. Comparison of clay fractions measured by different methods and characterised with different particle-size boundary

With the modified silt size lower limit similarity increased between the pipette method and the LDM data. The highest improvement was experienced here, the correlation coefficient (R^2) increased from 0.46 to 0.740 (*Figure 3*).

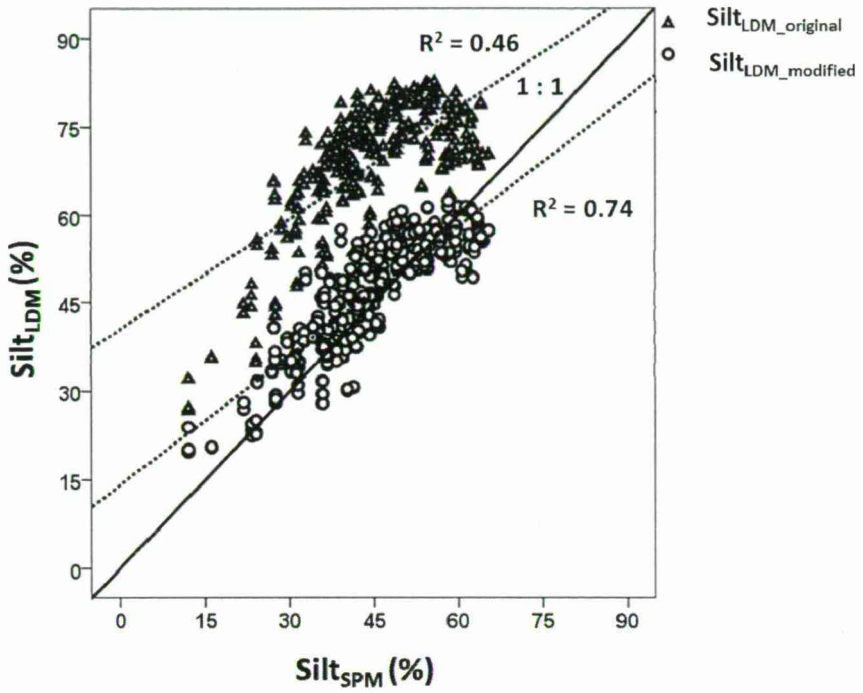

Figure 3. Comparison of silt fraction measured by different methods and characterised with different particle-size boundary

The two kinds of methods measure nearly same sand content (*Figure 4*).

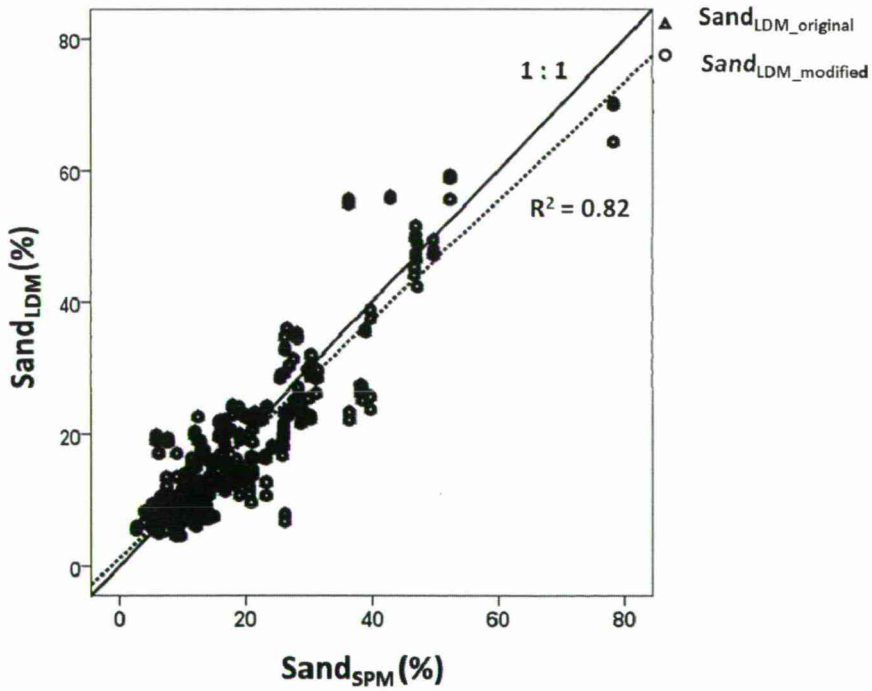

Figure 4. Comparison of sand fraction measured by different PSD methods

The match between soil texture categories, which were determined according to the USDA texture triangle, was significantly better in case of using the modified particle-size limits for the LDM (*Table 2*). Confusion matrixes (*Table 2*) illustrating the accuracy in correctly assigning the textural class of the measurements starting from either LDM data (original or modified clay/silt boundary) or sieve-pipette method (SPM) measured data.

Table 2. Confusion matrixes of textural classes' accuracy

$PSD_{LDM\_original}$	PSD_{SPM} C	CL	L	SACL	SAL	SI	SIL	SC	SICL	*Total*	
C	*0*	0	0	0	0	0	0	0	0	0	
CL	0	*0*	0	0	0	0	0	0	0	0	
L	0	0	*0*	2	0	0	0	0	0	2	
SACL	0	0	0	*0*	0	0	0	0	0	0	
SAL	2	0	7	6	*3*	0	0	0	0	18	*19%*
SI	0	0	1	0	0	*0*	2	1	7	11	
SIL	62	34	12	0	0	0	*58*	70	55	291	
SC	2	0	0	0	0	0	0	*0*	0	2	
SICL	1	0	0	0	0	0	0	0	*0*	1	
Total	67	34	20	8	3	0	60	71	62	325	

$PSD_{LDM\_modified}$	PSD_{SPM} C	CL	L	SACL	SAL	SI	SIL	SC	SICL	*Total*	
C	*26*	1	0	0	0	0	0	6	2	35	
CL	8	*20*	3	0	0	0	1	0	1	33	
L	0	4	*12*	4	0	0	0	0	0	20	
SACL	2	0	0	*1*	0	0	0	0	0	3	
SAL	0	0	2	3	*3*	0	0	0	0	8	*57%*
SI	0	0	0	0	0	*0*	0	0	0	0	
SIL	0	1	1	0	0	0	*43*	0	3	48	
SC	22	3	0	0	0	0	0	*26*	3	54	
SICL	9	5	2	0	0	0	16	39	*53*	124	
Total	67	34	20	8	3	0	60	71	62	325	

C:clay; CL: clay loam; L: loam, SACL: sandy clay loam; SAL: sandy loam; SI: silt; SIL:silty loam; SC: sandy clay; SICL: silty clay loam.

CONCLUSIONS

Applying usual size limits at the LDM, clay fraction was underestimated and silt fraction was overestimated compared to the pipette method, as international literature established, as well. Extension of particle-size limit of clay fraction from 0.002 to 0.0066 mm, and so changing the size limit of silt fraction to 0.0066 – 0.05 mm, causes more easy comparability and closer similarity between results of SPM and LDM. KONERT AND VANDENBERGHE (1997), MAKÓ ET AL. (2014a,b) and BARNA ET AL. (2015) got similar results. Comparability at 0.008 mm clay boundary (advised by KONERT AND VANDENBERGHE (1997)) was not as good as at 0.0066 mm (recommended by MAKÓ ET AL. (2014a,b) either in national, or in continental scale (results not shown). This change of fraction boundary can be the first step in conversion of results of different PSD methods. Subsequently soil texture classes determined from the LDM measurements significantly differ from results of the SPM, correspondence of texture classes is less than 60%. Therefore LDM analyses, even with modified fraction boundary, are not suitable for soil texture classification (TAUBNER ET AL., 2009; BARNA ET AL., 2015).

However, the used database size is still not enough for optimizing the particle fraction size limits. Further investigation will be carried out on a more detailed Hungarian database to harmonize PSDs of measuring methods.

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MAXIMAL SUSTAINABLE HARVESTING, AS A METHOD OF RAISING THE WILDLIFE MANAGEMENT'S INCOMES

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ABSTRACT
It is essential for wildlife management, as a sector of economy, to cover its own expenses and gain profit as well. Due to its special nature – since its resources are reviving, but limited – maximalizing the profit must be in line with sustainability of the management. The purpose of my research is the survey of its activities and analyzing the effect of different changes on the income. My calculations are based on data from the Hungarian Game Management Database (basic data from the yearly publications, and more detailed data used with special permit) and questionnaires.
Using the data I calculated whether the raised harvest rate were biologically sustainable, and what the amount of the additional income would be. My results are the following: the suggested harvest rates don't pass the maximal sustainable rate, so it can be used without lowering the populations, and almost 10% more income can be reached from game meat selling.

Keywords: game meat, game management, economical finances

INTRODUCTION

Nowadays money is one of the most important resources. The wildlife managers have to raise funds for their own running and management. They should harvest at the maximal sustainable rate so they obtain maximal income from the wildlife without damaging the populations (*Figure 1*).

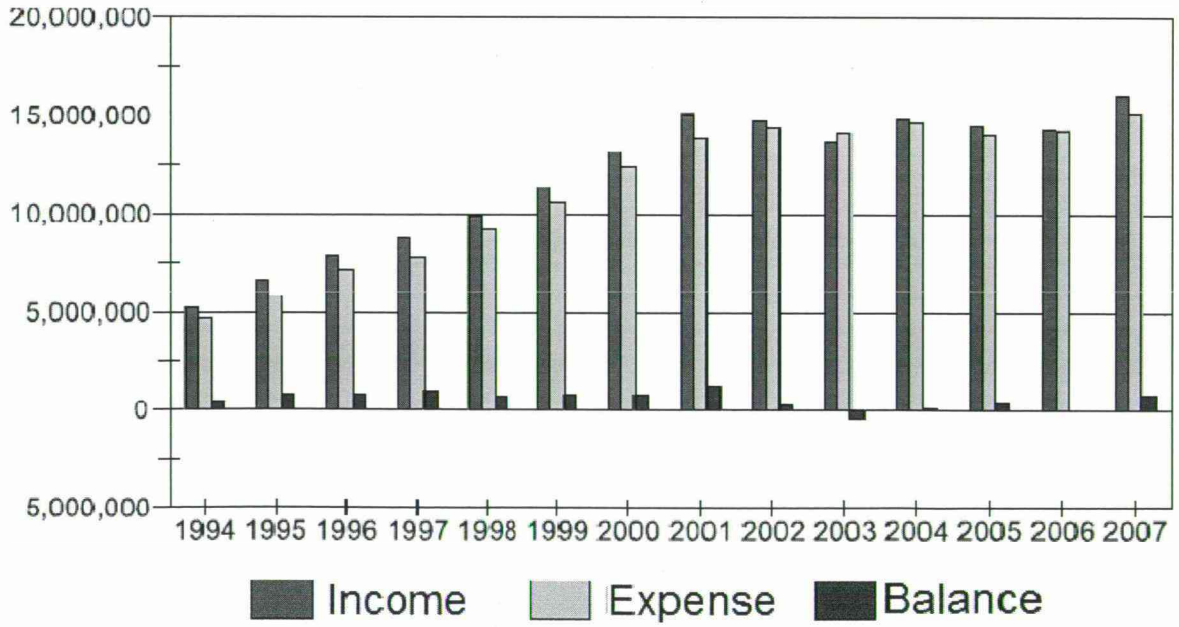

Figure 1. Wildlife management's incomes, expenses and balances between 1994 and 2007 (CSÁNYI ET AL., 2008)

The wildlife management's economic results can be tracked by its finances. Although the incomes are rising year by year, the expenses are rising at almost the same pace, so the profit isn't growing significantly.
The tendency hasn't changed since 2007. In 2013 the income is almost reaching the 20 billion Ft line, but the expenses are over 19 billion Ft, so the yearly profit is only 600 million Ft (CSÁNYI ET AL, 2014).
In this essay I search the answers to what kind of extra profits we can obtain from game meat using the maximal sustainable harvest rates.
My intention is making simple, illustrative models to analyse the extra profit's effects to the wildlife management's finances.

MATERIAL AND METHOD

I collected most of the data from the Hungarian Game Management Database. I gathered the yearly average game meat prices back to 1996 from the Öreglaki Game Meat Processor.
I systematized the data in Microsot Excel, and used the GraphPad InStat3 and InStat+ programs for the statistical analysis. I calculated the maximal sustainable harvest numbers for each year by adding the yearly bagged number and the difference of the following year's and the given year's estimated population size (can be a negative number).
I calculated with the extra game meat quantity of the females only because usually the females are under-harvested. The rates are the following by their natural biology: red deer: 50% hind and 50% fawn, wild boar: 25% piglet, 50% pig and 25% sow, roe deer: 33% doe and 67% fawn. The yearly average bodyweights are calculated from the Hungarian Game Management Database's data from each county. Finally, I multiplied the extra baggable numbers by the percentages shown above and by the yearly average game meat prices.

RESULTS

Red deer

The average maximal sustainable harvest rate of the red deer is 47,36% between 1996 and 2013. Between 2000 and 2013 this rate is 49,13%, and in the last 5 years it is 51,98%. So the harvestable number is increasing by number and by rate too.

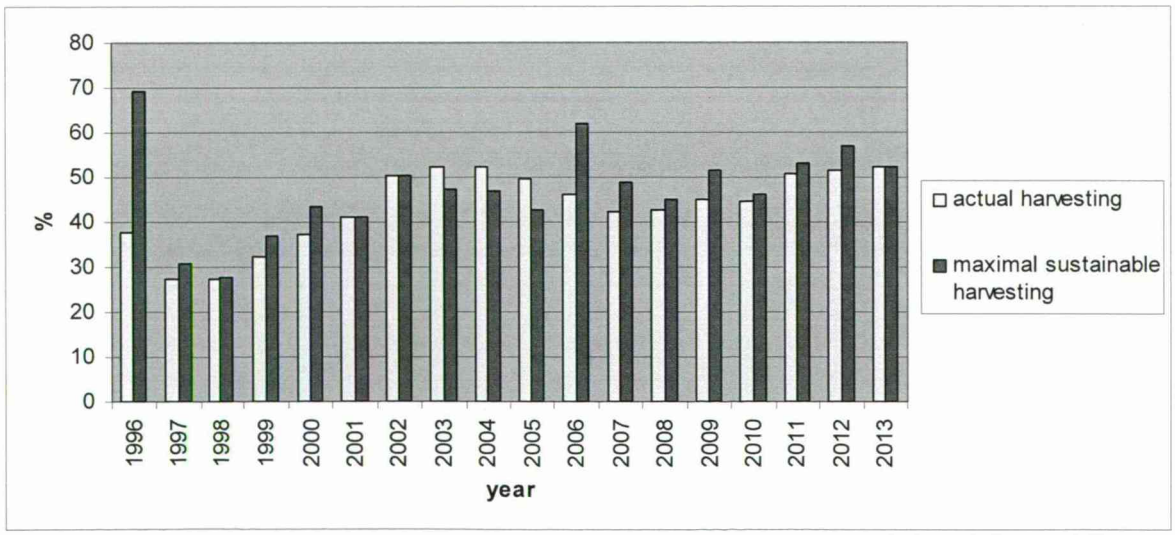

Figure 2. Red deer harvesting rates compared to the maximal sustainable harvesting rates between 1996 and 2013

I made the comparison of the actual harvesting rate and the maximal sustainable harvesting rate in *Figure 2.*

Red deer populations were under-harvested in 13 years, so the wildlife management units misses potential incomes. In the rest (5 years) they over-harvest the populations, so the number of individuals was reduced. The greatest reduction happened between 2004 and 2006, when the yearly over-harvesting number was almost 4500 specimen. However within only 2 years the population regenerated from this over-harvesting, and overran the previous maximal number.

Wild boar

The average maximal sustainable harvest rate of the wild boar is 106,23% between 1996 and 2013. Between 2000 and 2013 this rate is 110,28%, and in the last 5 years it is 122,14%. So the harvestable number and rate are both increasing. I made the comparison of the actual harvesting rate and the maximal sustainable harvesting rate in the following diagram (*Figure 3*).

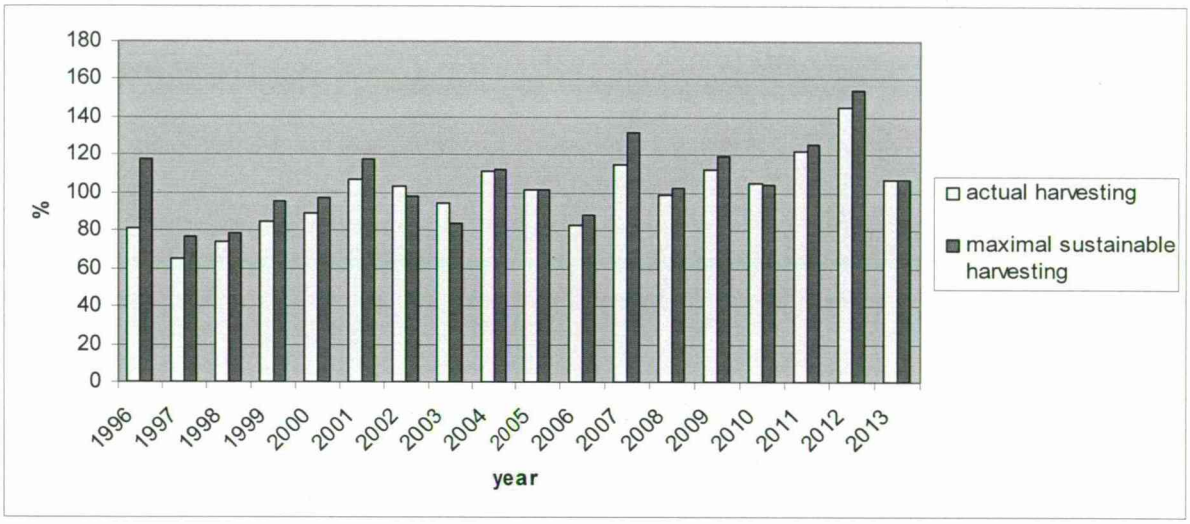

Figure 3. Wild boar harvesting rates compared to the maximal sustainable harvesting rates between 1996 and 2013

Wild boar populations were under-harvested in 14 years, and over-harvested in 4 years. The greatest reduction happened between 2003 and 2006, when the base population was reduced by 13410 individuals. However within 2 years the population regenerated from this over-harvesting, and so they estimated more boars for 2008 than for 2002.

Roe deer

The average maximal sustainable harvest rate of the roe deer is 25,34% between 1996 and 2013. Between 2000 and 2013 this rate is 26,85%, and in the last 5 years it is 27,73%. So, just like in the case of the red deer and the wild boar, the harvestable number and rate are both increasing.

I made the comparison of the actual harvesting rate and the maximal sustainable harvesting rate in the following diagram (*Figure 4*).

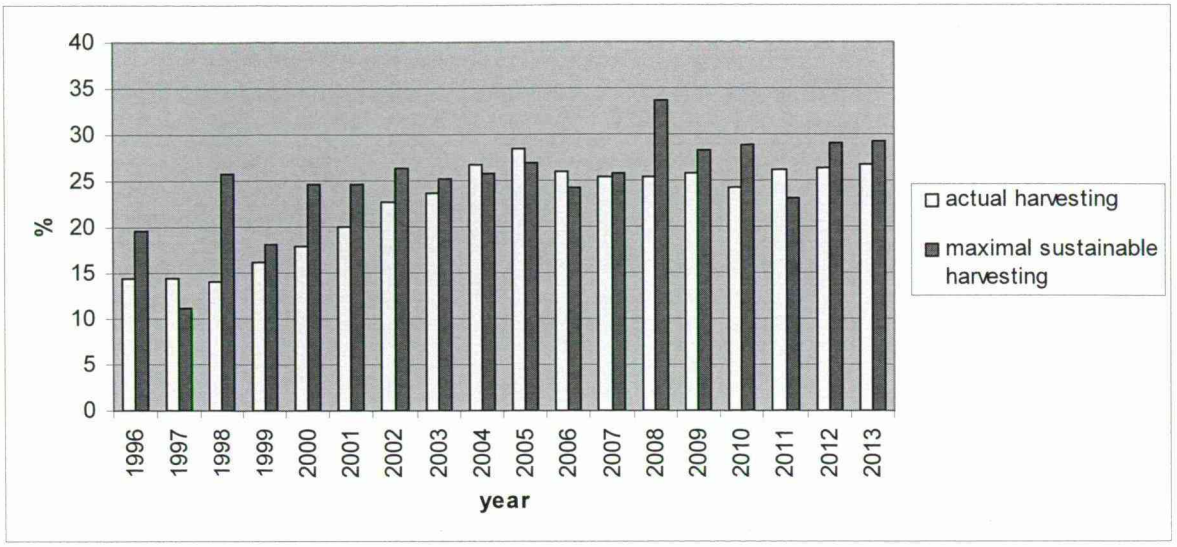

Figure 4. Roe deer harvesting rates compared to the maximal sustainable harvesting rates between 1996 and 2013

Roe deer poulations were under-harvested in 13 years, and over-harvested in 5 years. The greatest reduction happened between 2003 and 2006 (similar to the red deer's and the wild boar's case), when the base population was reduced by 4500 individuals each year. Further similarity is that the roe deer populations regenerated from this over-harvesting within 2 years as well.

POSSIBLE EXTRA PROFITS USING THE MAXIMAL SUSTAINABLE HARVEST RATES

After the establishment of the maximal sustainable harvest rates I calculated the highest possible extra profits by game meat. The following diagrams (*Figures 5-7*) should be examined year-to-year, because watching it by a simple cronologic line causes overestimation. Reaching maximal sustainable harvest rate in a year causes minor decrease in the following year's population (there is a constant number of the population instead of an increasing number)

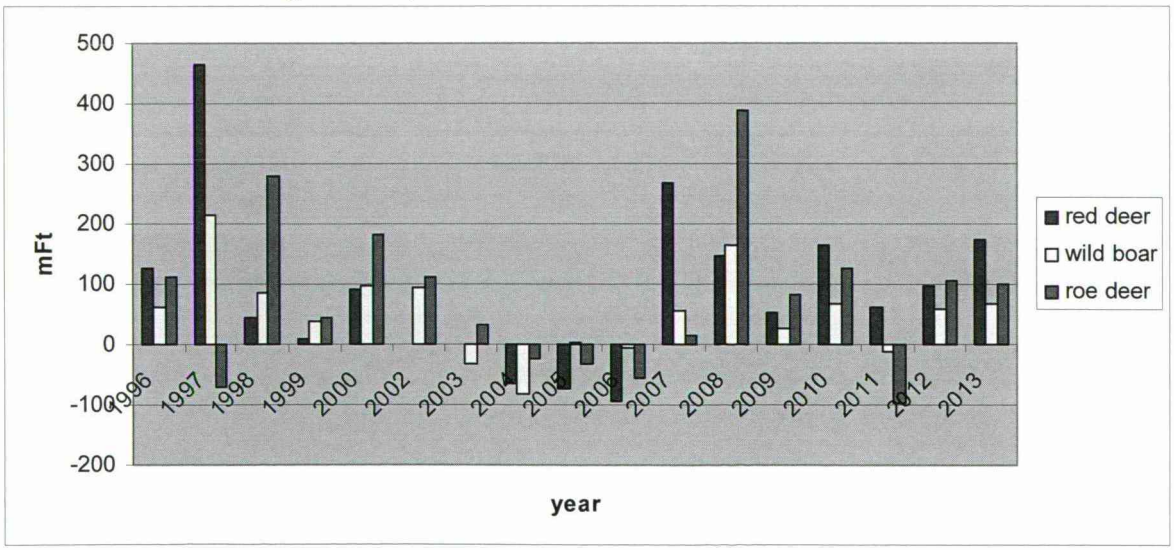

Figure 5. The differences of incomes with maximal sustainable harvest rates

As the previous analyses show, the populations can regenerate really fast from minor overharvesting, therefore I calculated the incomes without the loss of the overharvesting too. Finally I compared both versions with the incomes from game meat and the wildlife management's yearly balances.

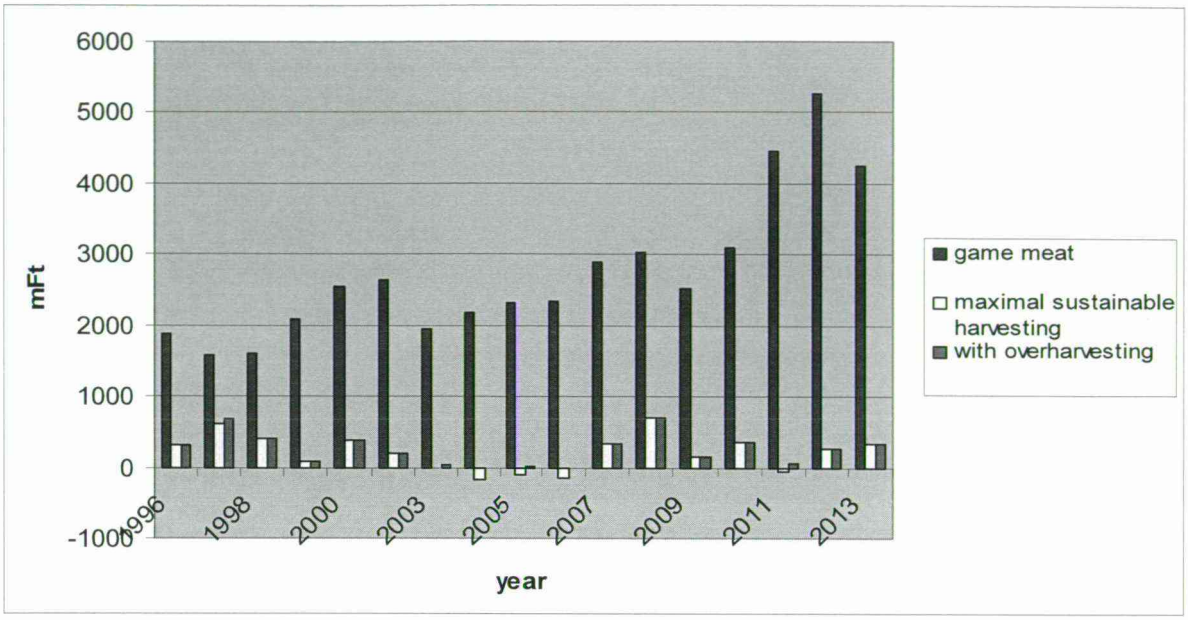

Figure 6. Relations of incomes from game meat and the extra incomes with and without income loss of overharvesting

Annual average of the incomes from game meat would have increased by 8,97% in the overharvested years with reduced incomes, and 10,6% without it. The minimum is 7,86% decreasing, maximum is 38,57% increasing, and the median is 7,88% increasing with maximal sustainable harvest rates. Without the overharvesting's yearly income reduction its minimum is not changing balances, maximum is 38,57% increasing, and the median is 7,88% increasing.

The most important question is: how does this affect the balances of the wildlife management?

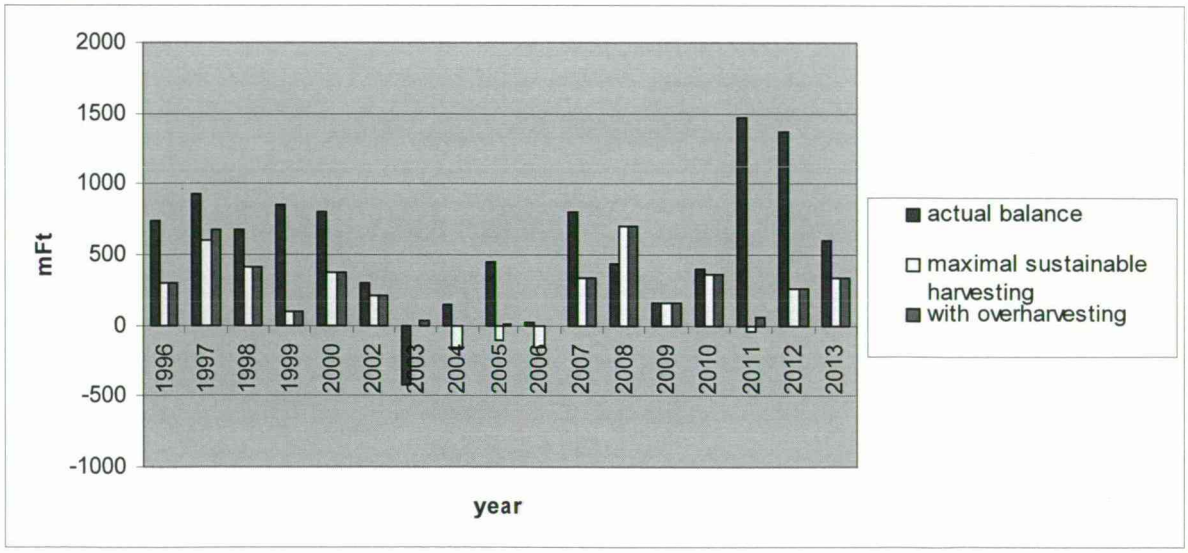

Figure 7. Relations of the yearly finances of the wildlife management and the extra incomes with and without income loss of overharvesting

Annual average of the finances is 8,83% decreasing with maximal sustainable harvest rates and 45,91% increasing without the income loss of overharvesting. The reason of the decreasing is the outstanding data of the year 2006, when the profit was only 20 million Ft, with overharvesting. Without that it would have been 135 million Ft less, so the ratio is -767%. Excluding 2006 data the yearly average is 38,58% increasing with maximal sustainable harvesting.
The minimum is 767,17% decreasing (in year 2006, because of the reason I described above), the maximum is 157,68% increasing, and the median is 41,92% increasing with maximal sustainable harvest rates. Without the overharvesting years income reduction its minimum is not changing balances, the maximum is 157,68% increasing, and the median is 41,92% increasing.

CONCLUSIONS

When increasing harvest rate, excess amount of game meat results excess incomes, which is one of the most important factors in every economical sector. At the same time, the maximal sustainable harvest rate model fits for the sustainability factor. The minor overharvesting model doesn't decrease the populations significantly, if they get overharvested only for 2-3 years in only a few percents.
The increase of incomes could be considerable with only a small extra input, in some years it could be more than 500 million Ft (the maximum was 700 million Ft in a year between 1996 and 2013). This extra income affects the incomes from game meat selling significantly, and in certain cases can raise the wildlife management's yearly balance by 250%. The 38,58% raising median in the modul is a result that is worth thinking about.
However, my model doesn't take into consideration whether the raised hunting pressure requires new professional hunters, and other additional costs. Because of this, the profit might be less than what I calculated. At the same time, the income from trophies of the males was not applied to the model either, so the incomes could be greater than the model's predictions.

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Non-publicated data from the Hungarian Game Management Database between 1996 and 2013

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POPULATION STRUCTURE AND GENETIC ASSOCIATION STUDIES IN WHEAT

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ABSTRACT
To define genetic diversity and population structure among a collection of wheat cultivars and lines of mainly European origin, Kompetitive Allele Specific PCR (KASP) technology was used to characterize a population of 95 bread wheat genotypes. In total, 860 of 960 tested markers were polymorphic and could be used for further analysis. Four subgroups of wheat genotypes were identified using Neighbor Joining (NJ) cluster analysis. Two of this subgroups comprised mainly varieties from Hungarian breeding programs (GrI, GrII); one subgroup contained varieties from Western Europe (GrIII) and one contained varieties with various origin (GrIV). GrI mainly contained genotypes originated from crosses including GK Kincső (Arthur 71/Sava) as one of the parents, or derivatives of this genotype. The results of this study should provide valuable information for future association mapping studies using this wheat collection. Furthermore, the genetic diversity and distance data combined with specific genotype data can be used by breeders to guide selection of crossing parents.

Keywords: wheat (*Triticum aestivum* L.), population structure, KASP, GK Kincső

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one the most important cereal crops worldwide. The genetic diversity conserved in wheat genebanks represents the genetic heritage of this crop. Knowledge of genetic diversity is important for understanding the extent of genetic variability in existing plant material and assessing relatedness among accessions is an important prerequisite for optimizing association studies (GARRIS ET AL., 2003).
Various types of molecular markers can be used for wheat genetic studies. They can be used for marker-assisted selection when tightly linked to target genes, and can also be employed to genetic diversity estimation in wheat germplasm. The evolution of cost efficient DNA marker platforms enable effective utilization of high density SNP (Single-nucleotide polymorphism) markers in research and breeding applications. KASP (Kompetitive Allele Specific PCR) is a uniplex PCR-based technology which is based on allele-specific oligo extension and fluorescence resonance energy transfer for signal generation. Against multiplex methods KASP technology has many advantages: shorter turnaround time, lower genotyping error rate (0.7-1.6%) and more flexibility. It can be used when there are many SNP markers in a few samples or when there are few SNP markers in many samples to analyze (SEMAGN ET AL., 2014).
Reasons for the presence of subgroups within larger germplasm populations can include differences in geographical origin, human or environmentally driven selection or genetic drift. Differences in allelic composition could be caused by different breeding practices and requirements (ROUSSEL ET AL., 2005). Additionally, differences along chromosomes can be caused by the introduction of certain germplasm in specific geographical regions. One example is *Sr36* stem rust resistance gene which was derived from *Triticum timopheevii* (MCINTOSH AND GYÁRFÁS, 1971) and was originally transferred into two

spring wheat lines and then into derivatives of these lines, e.g. Arthur 71 and TP-114-1965-A. Arthur 71 is an improved version of the high-yielding American soft red winter wheat Arthur (PATTERSON ET AL., 1975), which along with *Sr36/Pm6* stem rust and powdery mildew resistance genes carries many other disease resistance genes: *Sr2, Sr6, Sr8, SrTt1, Sr5, Sr8a, Lr9 , Lr14a , Pm2*. In Hungary, one of the first stem rust resistant cultivars was GK Kincső (Arthur 71/Sava) registered in 1980, which carries the *Sr36* gene (PURNHAUSER ET AL., 2011).

MATERIAL AND METHOD

Plant materials

In this study 95 hexaploid wheat varieties and lines were studied. 37 of this genotypes originate from the breeding program of Cereal Research Non-profit Ltd., Szeged, Hungary. The other 58 genotypes which were obtained from the Small Grain Cereal Genebank, Szeged, Hungary, are from different geographical regions, carrying traits important from breeding viewpoint. The distribution of the genotypes of the examined population by origin is presented in *Figure 1*.

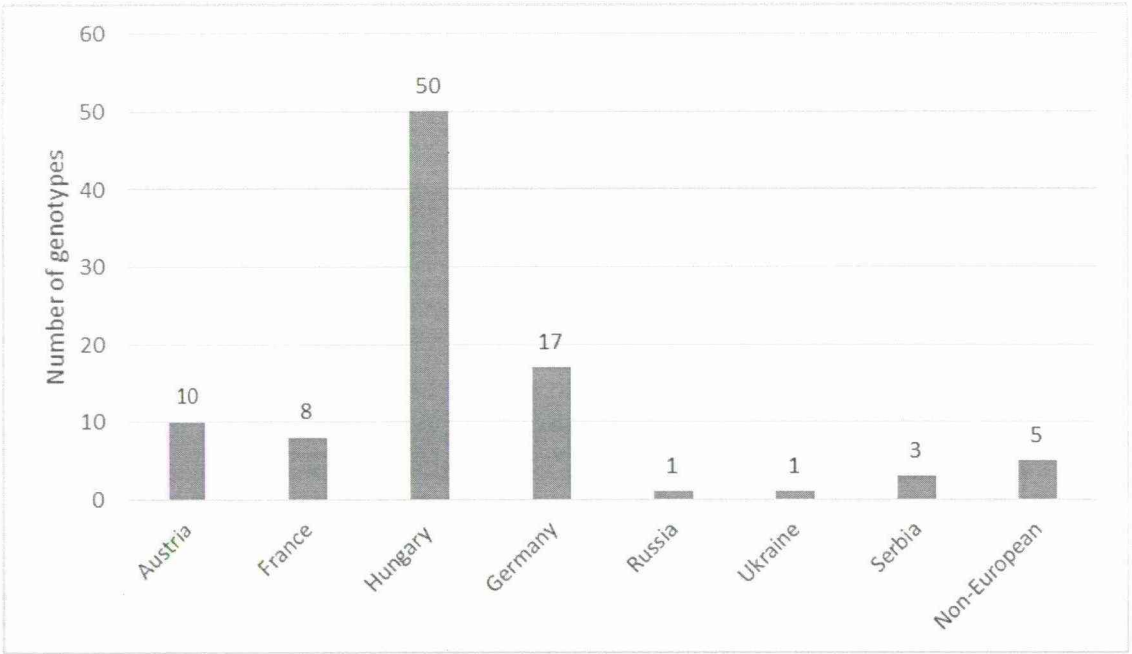

Figure 1. Number of genotypes of the examined population originated from different countries

DNA extraction and genotyping by Kompetitive Allele Specific PCR (KASP)

Genomic DNA from the 95 different genotypes was extracted using Wizard® Genomic DNA Purification Kit (Promega) according to the manufacturer's instructions. The quality and quantity of DNA were measured with NanoDrop 1000 Spectrophotometer (Thermo Scientific Company). The DNA was sent to LGC Ltd. (United Kingdom). The samples were examined using KASP technology (SEMAGN ET AL., 2014) with a set of 960 pre-validated SNP assays that are evenly distributed at 10 cM intervals throughout the wheat A, B and D genomes.

PCR conditions and primers

The 95 genotypes were evaluated with *Xgwm271* and *Xgwm477* SSR primer pairs associated with the presence of *Sr36* stem resistance gene (PURNHAUSER ET AL., 2011). The PCR products were separated using QIAxcel Advanced capillary electrophoresis system (Qiagen) according to the manufacturer's instructions (*Figure 2*).

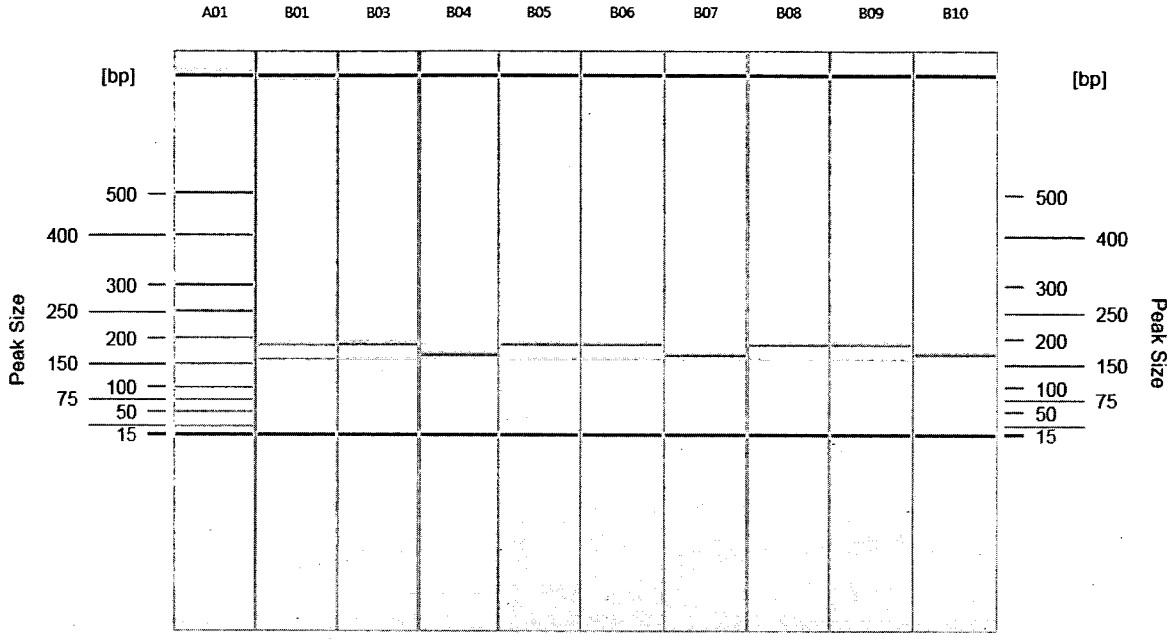

Figure 2. Amplification products obtained after PCR analysis with the *Xgwm477* SSR primer pairs, separated with the use of QIAxcel Advanced capillary electrophoresis (A01: Size marker 15bp-3kb; B01, B02, B05, B06, B08, B09: specific fragments associated with the presence of *Sr36* gene)

Cluster analysis

After the aligning of the marker data, mapped polymorphic marker data were used for performing Neighbor Joining (NJ) cluster analysis, which was carried out using TASSEL (v5.2) software.

RESULTS AND CONCLUSIONS

As a result of the survey of 960 SNP markers, 860 markers were polymorphic, which could be used for further analysis. 303 of these markers were distributed on the A genome, 319 on the B and 238 on the D genome.

NJ cluster analysis identified four subgroups within the test population. Two of the subgroups comprised mainly varieties from Hungarian breeding programs (GrI, GrII); one subgroup contained varieties from Western Europe (GrIII) and one contained varieties with various origin (GrIV). Comparing the segregation of the subgroups with pedigree data, it was found that one of the subgroups containing mainly Hungarian genotypes (GrI) contained principally genotypes which are derived from Arthur 71. Most of these genotypes are originated from crosses including GK Kincső (Arthur 71/Sava) as one of the parents, or derivatives of this genotype.

As GK Kincső was one of the first stem rust resistant cultivars in Hungary, and carries *Sr36* stem rust resistance gene, the whole population was genotyped with molecular

markers (*Xgwm271* and *Xgwm477*) associated with the presence of *Sr36* stem resistance gene. The marker data showed that 16 of the 95 genotypes carries the *Sr36* gene. All of this genotypes were placed in the GrI subgroup by the cluster analysis and the pedigree data show that all of them are derivatives of GK Kincső.

The result of this study agrees with the study of ROUSSEL ET AL. (2005) that the separation of the subgroups is affected by the geographical origin, and the introduction of a certain germplasm into a breeding program may have significant impact. It gives a confirmation by genotyping data about the defining role of GK Kincső in the breeding program of Cereal Research Non-profit Ltd., Szeged, Hungary.

These results should provide valuable information for future association mapping studies using this wheat collection. Furthermore, these data combined with specific genotype information can be used by breeders in selection of crossing parents based on their genetic distance.

ACKNOWLEDGEMENTS

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GROWTH PERFORMANCE AND SOME MORPHOLOGICAL TRAITS OF HONAMLI GOAT KIDS UNTIL WEANING AGE IN EXTENSIVE CONDITIONS*

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ABSTRACT
The aim of this study was to determine growth performance until weaning age of Honamlı goat kids reared in extensive conditions in Turkey. Study was carried out with 75 Honamlı kids (44 female, 31 male), kept at the Research and Training Farm of the Faculty of Veterinary Medicine of Mehmet Akif Ersoy University in Burdur, Turkey.
Birth weight of male kids was higher than that female kids and also birth weight of single kids was higher than that twin kids. Live weight in the 120th day of male, female, single and twin kids were 24.4 kg, 22.0 kg, 26.9 kg and 21.2 kg, respectively.
Withers height, body length, chest circumference and nose length on the 120th day were detected as 61.6 cm, 58.4 cm, 59.2 cm and 18.4 cm, respectively in female Honamlı kids. Same measurements were 63.9 cm, 61.7 cm, 62.7 cm and 20.0 cm for males Honamlı kids.

Keywords: Honamlı kids, body measurements, live weight, weaning age

INTRODUCTION

Honamlı goats are being reared by Turkish nomads in Antalya, Burdur and Isparta cities (Teke yöresi), located of the Taurus Mountains in the Mediterranean region of Turkey. The most of (97%) goats are Hair goat (Kıl goats) in Turkey. While the number of goats in Turkey in 2005 was 6 517 464, in 2015 it was 10 416 166. (TURKSTAT, 2015).
Honamlı goat by the authorities of the Ministry of Agriculture have registered as a new breed. Honamlı goat has a big body and long legs. The bottom jaw bone is longer than the top jaw bone (undershot jaw or monkey mouth). Its eye are clearly big and vivacious. Ears are small and thick. Nose is clearly convex. It is a submissive breed and so familiar and submissive (GDARP, 2009).

MATERIAL AND METHOD

Study was carried out with 75 Honamlı kids (44 female, 31 male), kept at the Research and Training Farm of the Faculty of Veterinary Medicine of Mehmet Akif Ersoy University in Burdur, Turkey. The flock was pastured on open range fields and forests from early in the morning until noon. Then the flock rested in a shaded area during noon and in the afternoon they continued to graze when the effect of the heat disappeared. In the evening the flock returned to their folds. In general, this district is poor in terms of amount and quality of pasture. Kids were suckling in the morning and at night and when they were 3 months old started to go out to the graze with their dams. The kids' weaning age was 120

days old. The live weights of the kids on the birth weight, 60th and 120th day were recorded. Live weights (LW) of kids were taken with sensitive scales up to 50 g at morning. Withers height, body length, chest circumference and nose length on the 60th and 120th day of kids were measured.

Descriptive statistics of the live weight and body measurements were determined by using Minitab version 12.0 software ANOVA GLM procedure (MINITAB, 2011).

RESULTS

Birth weight of male kids was higher than that female kids and also birth weight of single kids was higher than that twin kids. Birth weights of male, female, single and twin kids were 4.4 kg, 4.1 kg, 4.8 kg and 4.0 kg, respectively. Live weight, withers height, body length, chest circumference and nose length on the 120th day were detected as 22.0 kg, 61.6 cm, 58.4 cm, 59.2 cm and 18.4 cm, respectively in female Honamlı kids. Same measurements were 24.4 kg, 63.9 cm, 61.7 cm, 62.7 cm and 20.0 cm for males Honamlı kids.

Table 1. Mean live weight in the different periods according to sex of Honamlı kids (kg) ($\bar{x} \pm s_{\bar{x}}$)

	n	Birth weight	n	60th day	n	120th day
Female	**44**	4.1 ± 0,09	**44**	13,1 ± 0,35	**44**	22,0 ± 0,56
Male	**31**	4,4 ± 0,13	**31**	14,4 ± 0,66	**31**	24,4 ± 1,18
Overall	**75**	4,2 ± 0,08	**75**	13,6 ± 0,35	**75**	23,0 ± 0,60

Table 2. Mean live weight in the different periods according to birth type of Honamlı kids (kg) ($\bar{x} \pm s_{\bar{x}}$)

	n	Birth weight	n	60th day	n	120th day
Single	**23**	4,8 ± 0,12	**23**	16,1 ± 0,69	**23**	26,9 ± 1,19
Twin	**52**	4,0 ± 0,08	**52**	12,5 ± 0,29	**52**	21,2 ± 0,54
Overall	**75**	4,2 ± 0,08	**75**	13,6 ± 0,35	**75**	23,0 ± 0,60

Table 3. Mean±SE body measurements of Honamlı kids in different ages (60 and 120 days) ($\bar{x} \pm s_{\bar{x}}$)

Age (day)	Sex	n	Withers Height (cm)	Body Length (cm)	Chest Circumference (cm)	Nose Length (cm)
60th day	**Female**	**44**	54,4 ± 0,39	52,4 ± 0,38	50,6 ± 0,42	17,1 ± 0,14
	Male	**31**	55,3 ± 0,57	52,9 ± 0,62	52,1 ± 0,74	17,5 ± 0,21
	Overall	**75**	54,8 ± 0,33	52,6 ± 0,34	51,2 ± 0,40	17,3 ± 0,12
120th day	**Female**	**44**	61,6 ± 0,51	58,4 ± 0,48	59,2 ± 0,50	18,4 ± 0,17
	Male	**31**	63,9 ± 0,80	61,7 ± 0,93	62,7 ± 0,90	20,0 ± 0,35
	Overall	**75**	62,6 ± 0,46	59,8 ± 0,51	60,7 ± 0,51	19,1 ± 0,19

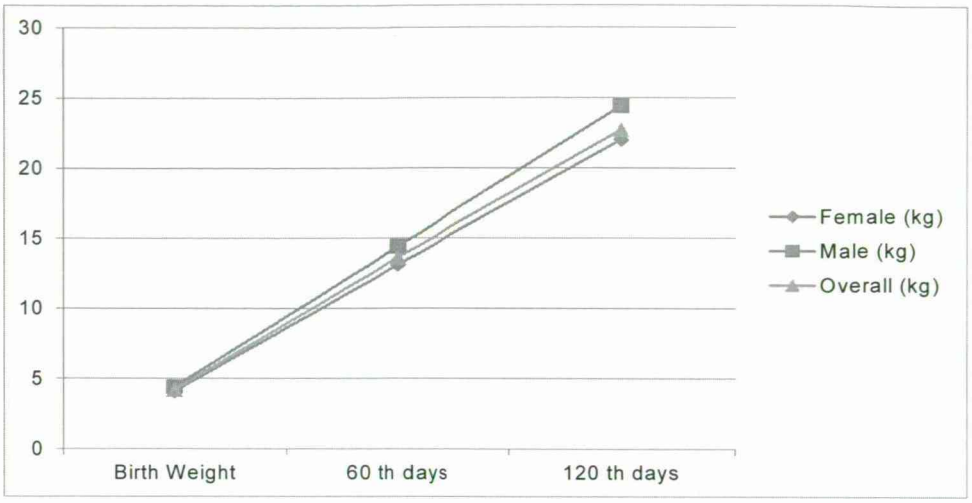

Figure 1. Mean live weight in the different periods according to sex of Honamlı kids

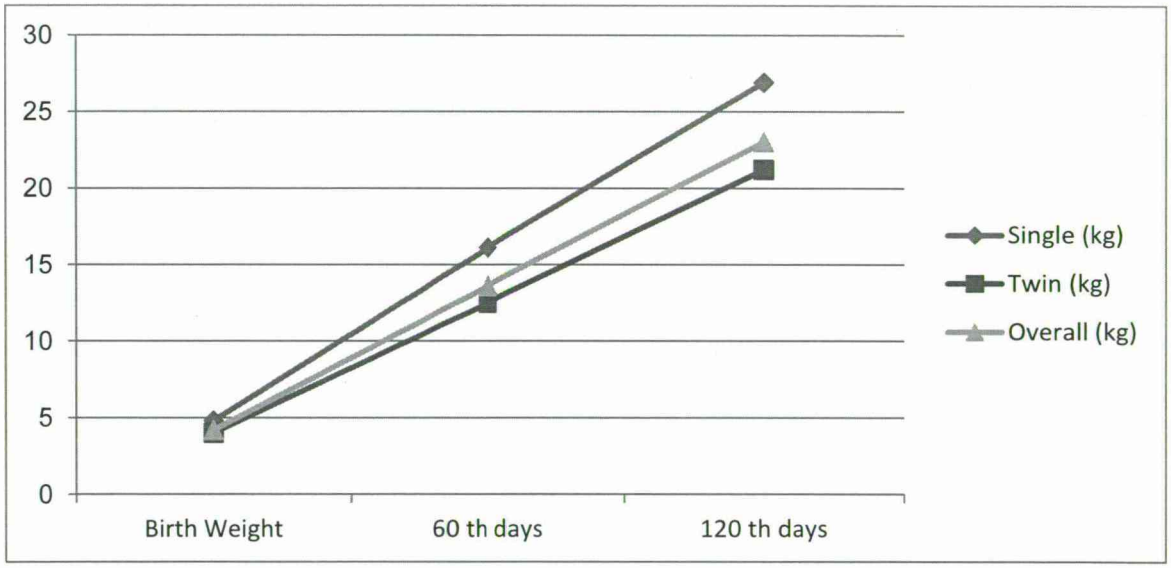

Figure 2. Mean live weight in the different periods according to birth type of Honamlı kids

CONCLUSIONS

The birth weight and live weights on the 120th days of Honamli kids were higher than the Hair kids in Turkey (ŞENGONCA ET AL., 2003; ŞİMŞEK AND BAYRAKTAR, 2006; ORAL AND ALTINEL, 2006). Siwty days live weight of Honamlı kids stated by ELMAZ ET AL., (2012) were heavier than the corresponding study. ŞİMŞEK AND BAYRAKTAR (2006) reported that the withers heights of the Kıl and Saanen x Kıl (F1) crossbred kids on were 44.6 cm and 45.5 cm, the body lengths were 43.0 cm and 43.4 cm, on the 90th day. These values were lower than the values obtained in this study. Body measurements of the Honamlı kids determined by this study were higher than the values reported by the literature.

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MAIZE (*ZEA MAYS* L.) GENEBANK FOR AGRICULTURE AND FOOD INDUSTRY

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ABSTRACT
Corn breeding can be successful only on a broad base of genetic material. The expansion of breeding aims includes the research of germplasm materials. In our experiments, we examined 11 blue, purple and red exotic corn varieties on two locations in Hungary. We conducted a complex study to obtain more information. We studied several morphological and phenological features and determined the most important qualitative parameters (protein, fat, ash). Results show that there are great opportunities in exotic corn varieties. Their quality exceeds that of the yellow ones in many cases. There are significant differences in yield and nutritional parameters. The favourable nutritional composition is not coupled with great productivity. Based on their flowering time and their agronomical features, they can be cultivated under Hungarian conditions as well. They match the new breeding aims, so they can be used as functional food or energy plants. The cultivation of alternative crops has an important role in world agriculture. Their market share is continuously growing in the food industry rector.

Keywords: maize (*Zea mays* L.), gene bank, agricultural and food industrial application

INTRODUCTION

Maize is the most important feed crop the use of which is very versatile. In many countries it is widely applied as an important food stuff for the population. In recent years modern industrial and agricultural countries have a developed corn processing industry. Nowadays, most research for improvement of corn production has focused on grain yield (ear, LAI, plant density, fertilization, etc.) traits because of agronomic importance (EL HALLOF AND SÁRVÁRI 2006; MOLNÁR AND SÁRVÁRI, 2006). Maize breeders are mainly concerned with combining ability and grain yield, but resource allocation into male and female fitness is unknown (VIDAL-MARTINEZ ET AL., 2004). Furthermore, artificial selection for higher grain yield has indirectly led to poor pollen production of negative correlations between male and female component fitness (GARNIER ET AL., 1993; VIDAL-MARTINEZ ET AL.,2001). In maize selection, it is of great importance to know the performances and combining ability of crossing partners. It is also relevant in seed production and basic research to study differences between single and reciprocal crosses. A few Hungarian literature references draw attention to this field (BERZY ET AL.,2005). KOVÁCS (1963) investigated direct and reciprocal single crosses derived from Martonvásár lines and found no difference between the productivity of two hybrids. Transportation of parents can be accounted by the fact that the cytoplasm of certain plants does not take part equally in the development of agronomical features. With the transposition of parents, more economical seed production is possible (NAGY, 1982). NAGY (1985) examined leaf number, ear height ear length, cob weight, 500 kernel weight, shelling %, and oil content in 14 early SC hybrids and their reciprocal varieties. In one quarter of compared data pairs, significance difference was found at P>5%. The main areas of further development in maize production

are yield safety, chemical composition and better utilization. Mutant population of richer varieties provides considerable help in solving these problems (PÁSZTOR ET AL., 1980). We have continued our research of the previous years into the selection of maize mutants as well as our studies of combining abilities and chemical characteristics of hybrids. The aim of these experiments is to determine the important values of mutant lines both for chemical characters and for yield components. The development of animal husbandry and maize production necessitated the improvement of the chemical composition of maize (MARÁZ ET AL., 1993; PEPO AND PEPO, 1993; PEPO, 1995). We produced genetically highly variable mutant population with fast neutron treatment of seeds from American maize hybrid material (F_1). From the starting basic material, with the use of radio mutation we created perspective hybrid-combinations by different genetic and breeding methods (PEPO ET AL., 1989).

MATERIAL AND METHOD

The experimental setup was randomized block design with four replilcation, furthermore, the distance between rows was 70 cm and among plants 20 cm. We investigated 32 morphological characters based upon CPVO TP2/2 standards and conducted zein analysis with isoelectric focusing based on ultrathin poliacrylamid gel electrophoresis. We isolated chromosomal DNA using QIAGEN DNeasy Plant Mini Kit. Extracted genome DNA was digested with 10 U EcoRI restriction enzyme, incubated with 1 U TruII at 67 C° and inserted AFLP adapters into it. The DNA was multiplicated with PCR and the DNA fragments were separated with capillaric electrophoresis.

RESULTS AND DISCUSSION

There is large genetic variation in the germplasm utilised, the exploitation of which is only possible using suitable methods of selection and evaluation. In 1985, we applied a physical mutant agent (fast neutron) for irradiation of F_1 hybrid seeds by 7.5-12.5 Gy dose. After selection, mutant lines were used for self-pollination over many years. As a result of this selection process, P26, P61 and P62 lines have been governmentally released by the OMMI (2001). These lines serve as a basic material in our future breeding programs. Identification and the origin of these genotypes are given in *Table 1.*

Table 1. Pedigree of registered inbred lines

Lines	Hybrids	Type of irradation	Dose [Gy]
P26	**F_1(Pi 3747 SC) M_2**	fn	7.5
P61	**F_1(Pi 3901 SC) M_2**	fn	12.5
P62	**F_1(Pi 3901 SC) M_3**	fn	7.5

f_1 : First generation after crosses
m_n : n^{th} mutational generation
fn : Fast neutrons (produced in a cyclotron)

As a result of mutagenic treatment, morphologically very different mutant populations were obtained. Radiation generated conspicuous changes in the plant characteristics described by UPOV in comparison with the basic material. The most pronounced aberrations were observed for the expression of anthocyanin coloration in various plant organs. The variability manifested in the changes of pollination interval. Flowering time is considered to be quantitatively inherited, and different studies have identified loci that affect this trait in maize (BEAVIS ET AL., 1991; CIT. OLIVEIRA ET AL., 2004). Mutation treatments (fast neutron) induced earliness in flowering time of different inbred lines. Using these lines as crossing parents, they could cause earliness in hybrids. With earlier flowering time, we can avoid frequent drought periods, which reduce fertilization in maize. Earlier maturity could reduce grain moisture in harvest time, drying energy and fungi diseases (e.g. Fusarium ear rot). These characteristics are suitable for sustainable agriculture. We concluded that the cyclotron can be successfully applied in widening genetic variability. We produced a number of inbred lines with wide genetic variability using mutation breeding. We can use this information to develop maize hybrids, which can be useful in our breeding program.

Genotypes of high antioxidant content, BM (Black Mexican) and ANB1, in addition to our own inbred lines (S1 and P49/1), and those back-cross hybrids were examined. Antioxidant and flavonoid content were determined by Folin-Ciocalteu method. Significant differences were observed among the antioxidant content of maize genotypes. Antioxidant and flavonoid contents of our maize hybrids (60.29% and 53.11%) were lower than that of the blue maize hybrids. The highest antioxidant content was detected in the BM line (168.0 mg), while the lowest antioxidant content was measured in the S1 parental line. Increase of antioxidant and flavonoid contents were observed in the first generation. In the second generation antioxidant content decreased in a small scale, but it was still high (*Table 2*).

Table 2. Flavonoid and antioxidant content

	Antioxidant			Flavonoid		
	content	relative %	absolute value	content	relative %	absolute value
S1	91.6	100.00	-	18.81	100.00	-
ANB1	134.0	146.28	42.4	21.17	112.54	2.36
(ANB1xS1)F_1	121.0	131.00	29.4	25.42	135.14	6.61
$SzD_{5\%}$	6.5			2.73		
P49/1	96.8	100.00	-	18.81	100.00	-
BM	168.0	173.55	71.2	36.44	193.72	17.63
(BMxP49/1)F_1	160.0	165.28	63.2	32.44	172.46	13.63
(BMxP49/1)xP49/1F_2	141.0	145.66	44.2	27.35	145.01	8.54
$SZD_{5\%}$	4.34			3.22		

Corn breeding can be successful only on a genetic material of broad base. The expansion of breeding aims includes the research of germplasm materials. In our experiments, we examined 11 blue, purple and red exotic corn varieties on two locations in Hungary. We conducted a complex study to obtain more information. We studied several morphological

and phenological features and determined the most important qualitative parameters (protein, fat, ash). We applied the Tassel Area Index (TAI) under Hungarian conditions, and compared it with the pollen producing ability of different genotypes. Results show that there are great opportunities in exotic corn varieties. Their quality exceeds that of the yellow ones in many cases (*Table 3*). There are significant differences in yield and nutritional parameters. The favourable nutritional composition is not coupled with great productivity. Based on their flowering time and their agronomical features, they can be cultivated under Hungarian conditions as well. They match the new breeding aims, so they can be used as functional food or energy plants. With their high pollen producing ability and TAI, they can be utilized as markers in future pollen research.

Table 3. Protein, fat and ash contents (%) of investigated blue and purple kernel corn genotype (1), protein content (2), fat content (3), ash content (4), check yellow corn (5), significant at P=5% probability levels for comparison with control

Genotype (1)	Kernel colour (5)	Protein (2)	Fat (3)	Ash (4)
Hopi Blue	**blue**	**10.62***	**4.73***	**1.59***
Blaumais	**blue-brown**	**11.69***	**3.22**	**1.53***
Taos P. B.	**blue**	**8.65**	**6.11***	**1.42**
Alamo N. B.	**blue**	**8.86**	**6.51***	**1.50***
Purple Red Flour	**blue**	**9.79***	**6.33***	**1.35**
Sandia P. Black	blue	8.13	5.11*	1.33
Santo D. Blue	blue-purple	9.81*	4.68*	1.36
Hopi Turquoise	red	11.26*	-	1.61*
DK 471 (Kontroll)(5)	red	7.36	3.12	1.23

The primer combinations were used as AFLP markers producing 207 bands, 70 of them being polymorphic. We used IEF (Isoelectric Focusing) of zein to determine the genetic similarities between lines. We found 15 bands with this technique. The dendrogram based on genetic similarities (GS) and morphological description separated the four studied inbred lines into well-defined groups. Morphological description, AFLP and zein analysis revealed the same reliable results (*Figures 1-2*).

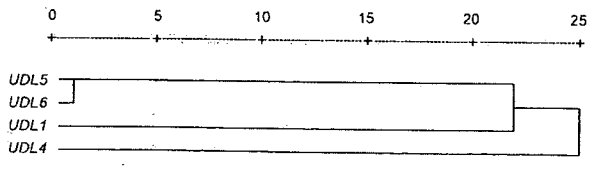

Figure 1. Dendrogram obtained by cluster analysis based on the zein patterns of four maize inbred lines. (1) Distance, (2) Line

Our results suggest that AFLP and analyses seem to be efficient techniques to determine the genetic similarities/differences between different genotypes. Considering the genetic distance values, the UDL1 line and its hybrid with UDL6 in both directions showed significant heterosis effect which was confirmed by heterosis calculation based on grain yield.

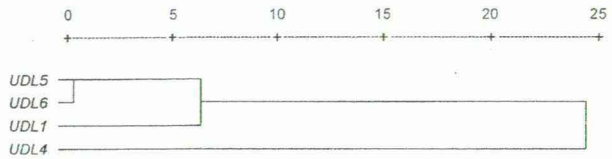

Figure 2. Dendrogram obtained from cluster analysis based on the AFLP amplification patterns of four maize inbred lines. (1) Distance, (2) Line

Knowledge of genetic diversity among available parental inbred lines is fundamental for successful hybrid maize breeding. Clustering of inbred maize lines according to their genetic background is important for breeding, as a certain genetic distance between the parental lines is essential to predict the heterosis effect. The aims of our study were to estimate (1) genetic similarity (GS) of four maize inbreed lines, (2) to classify the lines according to their GD and GS values, (3) to determine their hybrid performance based on CPVO TP2/2 AFLP and zein patterns to estimate genetic polymorphism of four maize inbred lines. We estimated the applicability of genetic similarity values in SC and reciprocal hybrids to predict their performance in a complete diallelic crossing.

CONCLUSIONS

In the past, conventional breeding methods have been quite successful in improving crop yields throughout the world. Conventional breeding methods, however, are laborious and time and space consuming. Successful employment of additional methods and biotechnology could accomplish development of plants, this making breeding process more efficient in the use of critical resources. Hungarian maize production utilises many foreign hybrids that are derived from only a few inbred lines. Because of this genetic vulnerability, production can be in a serious danger and quick gene erosion is a possibility. During the past ten years, maize production level has remained unchanged and opportunity of further development would develop new inbreeds with desirable agronomic attributes.

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THE IMPORTANCE OF AGRICULTURE IN THE DEVELOPMENT OF ROMANIAN ECONOMY

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ABSTRACT
Agriculture represent one of the most important branches of the Romanian economy. Within performing the suggested analysis we started from the premise that the economy of each country, regardless of developing degree, agriculture, by natural and human resources available, by contributing to the creation of gross domestic product, of gross value added, but also by participating at internal and external trade, obviously holds an important position.
Romanian rural economy is currently dominated in a large part by agriculture. Favorable geographical conditions, topography, climate, fertile soils, in addition with workforce, a suitable administrative system, but the connection of rural population to land and animals can make the Romanian agriculture as production branch attractive and profitable to determine economic growth at national level.
Thus, we considered necessary to perform an analysis concerning the importance of Romanian agriculture, analysis that represents the basis for finding the most viable solutions to determine this particularly important branch - to relaunch in the development of Romanian rural economy.

Keywords: agriculture, rural development, economic growth

INTRODUCTION

Every country has a specific economic structure determined by its level of development, historical evolution and by its specific policy of regulating social life (FEHER ET AL., 2012).
The privatization process in Romania started in 1990, proved to be a much more complex and more difficult than was originally thought. In the first period after 1990 the process was slowly being determined by: the lack of political will, mentality and indoctrination of population, by institutional problems, as well by a slow establishing of a necessary legal framework.
Within agriculture, the evolution was much faster and with great leaps even since the early years of transition. Otherwise the privatization process started in agriculture within the cooperative sector in the spring of 1990.
Romanian agriculture has evolved in the period after 1990 under the influence of phenomena generated by the transition towards a market economy, on the background of shortage of financial resources and material, as well of an unfavorable international recession (STERIU, OTIMAN ET AL., 2013).
Land Law 18/1991 divided agricultural lands into small parcels and determined their dispersion, to which was added the depreciation of the material basis, the stagnation of investments, asset damage, as well as mistakes occurred in the management of state-owned assets and supporting the process of establishing private agriculture, which led to the sharp decline of farms profitability.
Currently, Romania continues to be known as "the most rural country in Europe" (NIS SOCIAL TRENDS, 2016).
Statistics show that nearly half of the country population is represented by the rural population, meaning 9, 71 million people (46%).

The majority of rural inhabitants are employed in agriculture, forestry and fisheries (41.3%) while only 32.6% work in the secondary sector and 26.1% in the tertiary sector. Most of those working in agriculture are their own employees and the number of employees in agriculture represents only 5.45% of total number of employees in the economy.

MATERIAL AND METHOD

The methods used at elaboration of the present work are: analysis, synthesis, comparison, deduction or induction. The data used were taken from statistics of European Commission, Eurostat and national statistics, also from various national and international publications, on which we made own calculations and interpretations. The indicators used in this analysis are the followings:

1. *Gross domestic product* which is equivalent to the amount of gross value added of various institutional sectors or of various branches of activity, to which is added taxes and are deducted subsidies on products (which are not allocated to sectors and activity branch). In the same time it represents the production balance of the total economy. The value of gross domestic product is expressed in current and comparable prices.
2. *Gross value added* which represents the balance of production, meaning the new created value in the production process.
3. *Net investments* represent expenditures made for construction works, installation and assembly, equipment purchase, transportation and other expenses intended for the creation of new fixed assets, for development, modernization, reconstruction of the existing ones, as well as the value of services related to ownership transfer of existing fixed assets and lands (notary fees, commissions, costs of transport, loading and unloading, etc.).
4. *International trade* includes all operations of import and export regarding goods, works and services carried out by individuals or entities having the quality of subjects of international trade right with partners of foreign nationality or with goods at international transit.
5. *Trade balance* represents the net difference between the value of imports and exports of goods within a country in a given period of time.

RESULTS AND DISCUSSION

Across the entire national economy, agriculture represents one of the branches of major importance, which can contribute to the revival of economic growth of the country, especially since the role that agriculture has, it cannot be substituted by any other economic activity due to the fact that food demand is essential and has a permanent character for human existence on the one hand, and on the other hand agriculture provides raw material needed for the revival of many other industries (agro-food, textile, chemical, pharmaceutical, cosmetics, handicrafts etc).

The contribution of agriculture to economic development can be determined by performing an analysis of the multiple functions which are accomplished by this, as well by its contribution at the balance and social stability and not only, in the light of the share of this branch in the formation of outcome indicators such as gross domestic product and added value (GOŞA ET AL., 2013).

Through agriculture, every nation must ensure food security of the population, meaning the possibility for all citizens to have permanently a sufficient amount of food to lead an active and healthy life.

Nationally, agriculture is one of the main branches of the Romanian economy with a relatively high share in gross domestic product (*Table 1*).

Table 1. The share of agriculture and forestry to GDP (million euro)

Indicator/Year	2001	2003	2005	2007	2009	2011	2013	2014	2015*
Total GDP	44866	52607	79532	124653	120483	133344	144253	149988	159790
GDP of agriculture and forestry	5999	6080	6700	7181	6555	8580	7785	7106	6698
% of GDP	13.4	11.6	8.4	5.8	5.4	6.4	5.4	4.7	4.2

Source: National Institute of Statistics, Tempo Online database;
* National Institute of Statistics, Press Release, Nr. 54 of March 8th, 2016

The contribution of agriculture and forestry to GDP in the year 2001 had a share of about 13.4%, and in the year 2015 approx. 4.2%. Although the contribution of agriculture to GDP has declined pretty much the period under review, it continues to hold a high share compared to developed countries, EU countries, where agriculture's contribution to GDP does not exceed 2% (*Table 2*).

Table 2. Structure of Gross Value Added (GVA) in the EU 2014

Country	Agriculture	Industry	Constructions	Trade, Transport, Accommodation and Food	Others
Austria	1.54	21.74	6.90	21.89	47.94
Belgium	0.79	15.56	5.75	19.79	58.12
Bulgaria	4.95	25.19	5.60	19.50	44.77
Czech	2.39	31.81	5.95	19.19	40.66
Cyprus	2.67	8.74	4.05	24.32	60.22
Croatia	4.41	21.01	5.28	20.66	48.64
Denmark	1.31	16.88	4.60	19.70	57.51
Estonia	3.61	21.46	7.61	23.19	44.12
Finland	2.84	18.73	6.84	17.00	54.59
France	1.80	12.79	6.05	18.18	61.18
Germany	0.78	25.53	4.68	14.48	54.54
Greece	3.71	14.64	1.82	22.71	57.12
Ireland	1.85	26.34	1.68	15.58	54.55
Italy	2.15	18.29	5.61	20.83	53.12
Latvia	4.89	18.69	6.39	29.14	40.89
Lithuania	3.84	24.54	6.54	33.20	31.87
Luxemburg	0.34	5.88	6.25	17.62	69.91
Malta	1.66	12.83	4.10	21.02	60.39
Great Britain	0.64	14.33	6.06	18.46	60.51
Netherlands	1.65	19.65	4.72	18.61	55.37
Poland	3.79	24.73	6.54	27.28	37.66
Portugal	2.41	18.90	4.29	25.37	49.04
Romania	**6.38**	**34.26**	**9.19**	**12.51**	**37.66**
Slovakia	2.95	26.65	7.56	22.82	40.01
Slovenia	2.90	25.72	5.67	20.61	45.10
Spain	2.58	17.46	7.84	25.90	46.21
Sweden	1.51	18.81	5.38	17.51	56.78
Hungary	4.80	26.03	4.11	17.57	47.48
Total EU 28	1.68	19.06	5.67	18.98	54.61

Source: Own calculations based on Eurostat online database

In developed countries, agriculture participates with a share more than the gross value added (GVA), which warranted the development at a sustained pace of other sectors such as services, trade, construction, financial, banking, insurance, whose participation is growing to achieve gross value added.
In Romania agriculture's contribution to GVA in the year 2014 was of 6.38% while the EU average is 1.68%. The large share of Romanian agriculture compared to other EU countries to GVA formation at economy level is due to the too slow growth process of the share of services and trade to total gross value added.
In what concerns the Romanian agriculture investments in the period under review, these accounted on average for 4.12% of the total allocated investments according to the table below (*Table 3*).

Table 3. The evolution of investments structure in Romania, %

Specification	2008		2009		2010		2011		2012		2013		2014	
	Mil. €	%	Mil. €	%	Mil. €	%	Mil. €	%	Mil. €	%	Mil. €	%	Mil. €	%
Agriculture	921	3.41	689	3.90	632	3.68	775	3.74	757	3.78	963	5.27	988	5.10
Industry	8709	32.22	6060	34.27	6458	37.61	7813	37.71	7971	39.87	7845	42.88	7890	40.70
Constructions	3676	13.61	2166	12.24	2192	12.76	2985	14.40	2929	14.65	1995	10.90	1434	7.40
Trade	3911	14.47	2118	11.98	1625	9.46	1980	9.55	1937	9.69	1727	9.44	1826	9.41
Others	9808	36.29	6653	37.61	6266	36.49	7170	34.60	6400	32.01	5766	31.51	7247	37.39
Total	**27025**	**100**	**17686**	**100**	**17173**	**100**	**20722**	**100**	**19994**	**100**	**18296**	**100**	**19385**	**100**

Source: Processed data from the National Institute of Statistics, Tempo Online database

In these circumstances we can not talk about investments for development, but mostly only capital allocation for replacement of fixed assets.
In the year 2014, crop production represented 65.83%, while livestock production accounted for only 32.85% of total agricultural production (*Table 4*).

Table 4. The evolution of sectors shares in agriculture

Specification	2011		2012		2013		2014	
	mil. € current prices	%	mil. € current prices	%	mil. € current prices	%	mil. € current prices	%
Vegetal	12784.58	70.82	9014.62	62.51	12184.61	68.62	11037.74	65.83
Livestock	5140.31	28.47	5286.19	36.66	5403.15	30.43	5508.17	32.85
Agricultural services	128.55	0.71	120.08	0.83	168.37	0.95	221.50	1.32
TOTAL	**18053.44**	**100**	**14420.89**	**100**	**17756.13**	**100**	**16767.41**	**100**

Source: Processed data from the National Institute of Statistics, Tempo Online database;

According to data from the above table, we find also that the share of livestock sector is low, although it discusses continuously of a share increase of this sector. Unfortunately, livestock have fallen sharply in the past 25 years mainly due to lack of animal slaughter establishments and of establishments for processing products from the livestock sector.
Low competitiveness of the obtained products is the main problem of the Romanian agriculture and the agricultural products can hardly find marketing on international market. The main exported products of Romania were wheat and corn with over 1.988 million euro in 2014. Romania thus is exporting large quantities of cereals to the detriment of their

internal recovery through livestock, which could lead at increasing the added value of such products (*Table 5*).

Table 5. International trade with agricultural products

-million euro-

NC	Specificat.	EXPORT							IMPORT						
		2008	2009	2010	2011	2012	2013	2014	2008	2009	2010	2011	2012	2013	2014
I	**Live animals and animal products**	278	326	434	584	731	745	744	1191	1116	984	965	1035	1114	1223
II	**Crop products i.e.**	1198	1125	1625	2097	1970	2985	3068	1259	1003	1141	1324	1416	1455	1514
	Cereals	638	631	893	1095	1336	1981	1988	308	250	248	333	373	327	256
III	**Animal and crop fats and oils**	106	88	164	242	183	240	212	227	160	217	245	239	205	164
IV	**Food, beverages and tobacco**	583	704	890	1099	1160	1315	1549	1669	1544	1584	1911	2100	2177	2219
Total		2165	2243	3113	4022	4044	5285	5573	4346	3823	3926	4445	4790	4951	5120

Source: Minister of Agriculture and Rural Development;

Table 6. The trade balance (export-import)

-million euro-

	2008	2009	2010	2011	2012	2013	2014
Total products NC I-IV	**-2181**	**-1580**	**-813**	**-423**	**-746**	**334**	**453**
Live animals and animal products	-913	-790	-550	-381	-304	-369	-480
Vegetal products,i.e.	-61	122	484	773	554	1530	1554
Cereals	330	381	645	762	963	1654	1691
Animal and crop fats and oils	-121	-72	-53	-3	-56	35	49
Food, beverages and tobacco	-1086	-840	-694	-812	-940	-862	-670

Source: Minister of Agriculture and Rural Development;

The trade balance of agricultural products in the last 2 years is overall positive. For vegetal products, the balance is positive since the year 2009. The most favorable situation is seen in the case of cereals, where the difference between exports and imports has increased constantly. At live animals and animal products there have recorded a downward trend in the deficit (*Table 6*).

The first year with overall positive balance was the year 2013 (334 million euros), mainly due to crop products, to which exports exceeded imports by 1 530 million euros.

At food, beverages and tobacco, the deficit was maintained around the average value on 7 years of about 840 million euros.

Department stores (supermarkets, hypermarkets) prefer to sell imported products to which they have a faster access, while Romanian agricultural products still hardly find the route to the final consumer.

From this very important point of view results that local producers must associate in order to capitalize production, especially since the competition from EU countries remains high.

CONCLUSIONS

In the situation where Romania's agriculture is characterized by a high degree of fragmentation of farmlands, low investments, poorly qualified workforce, aging and with a precarious financial situation, that lives mostly at subsistence limit, we believe that the revival of this branch so important for our country's economy can only be achieved by attracting European funds and through massive investments (FEHER ET AL., 2015).
Romanian producers should act in accordance with the existing economic realty nationally and globally and to apply technical and economic methods in order to provide them stability and economic efficiency;
Agricultural products capitalization is not well organized, the route from farmer producer to final consumer meets syncope which lead to losses for both producers and consumers;
In the year 2014, the trade balance was positive by 453 mil. Euro. Exports, respectivelly imports of agricultural products represented 10.6% of total value of exports FOB, accounting for 8.7% of the total value of imports CIF.
Romanian agriculture benefited during the period 2007-2013 from European funds under the National Rural Development Programme worth around 8.124 million euros to which is added 2,000 million euros from domestic budgetary resources. In this period there were attracted approximately 8.457 million euros, meaning an absorption degree of 90.97%.
For the period 2014-2020, there have been allocated to Romania European funds amounting to 8.015 million euros to develop the agricultural sector. These amounts should be targeted in particular to develop the livestock sector, and the food industry to stop exporting cereals and thereby to increase the value of these products.
We strongly advocate that agriculture must become a real priority for the Romanian government for it must ensure food security for the population but at the same time it must provide raw material for many other activities.

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COMPARATIVE ANALYSIS OF THE STRATEGIC OBJECTIVES OF EUROPEAN UNION FOR THE PAST PROGRAMMING PERIOD 2007-2013 AND FOR THE CURRENT PROGRAMMING PERIOD 2014-2020

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ABSTRACT
The growing competition between different regions, thus their activities performed under both within and outside the European Union represents a fact of the "globalized" world in which we are living.
For many years, the regional disparities in terms of development level and life quality were subject to national policies of the Member States. Many improvements have been observed since the European Union initiated the policy of reducing them.
The Cohesion Policy of the European Union has an unique irreplaceable role in the coagulation of integrated development strategies, comprising interventions in different areas, such as infrastructure, research and innovation, employment, education, business, environment protection, climate changes and energy efficiency within a package of coherent policies addressing to regional or even local context, being one of the most visible policies, especially in what regards the relationship with citizens. Thus, the Cohesion Policy target is represented by supporting the process of reducing the disparities between the regions and Member States more developed of the European Union and the ones that are less developed.

Keywords: Cohesion Policy, strategic objectives, programming period

INTRODUCTION

The enlargement of the European Union had led at increasing the gaps of economic development between old and new Member States, whose level of development is much lower. With the entry into the European Union (EU) of the new members, the Gross Domestic Product (GDP) environment/capita of the EU decreased by 12.5%. Also, one in four regions at NUTS II level of the European Union has a GDP/capita of less than 75% of the Community average. Beyond the GDP statistics, there are still complex inequalities between Member States and the other regions, due to differences regarding the followings:

- infrastructure;
- quality of the environment;
- unemployment and workforce skills relevant to development;
- size and diversity of business;
- level of innovation and the use of technology in business.

In order to recover the wasted years in a system that thought differently the economy, freedom and development, and to assert within the European Union of a healthy nation, prosperous, educated, free and dignified, the European integration of Romania should be seen as a process to contribute to economic development, to participate with performance and competitiveness on the internal market of European Union. Within the current conditions, where the Romanian economy is still facing structural problems serious enough, we need coherent and unitary strategies aiming at scheduling, prioritizing and pursuing national development policies.

MATERIAL AND METHOD

The methods used were analysis, synthesis, comparison method, deduction and induction. The materials and data used were taken from the Ministry of European Funds, and from various national and international publications, on which we made own interpretations.

RESULTS AND DISCUSSION

The Cohesion Policy has its primary legal basis in the text of EU Treaty (Title XVII "Economic and Social Cohesion" and Art. 148 on the European Social Fund) (CATANĂ, 2007). The aim to strengthen economic and social cohesion is mentioned explicitly in the Article 2 of the Treaty of Amsterdam, being a valued objective of the European Union. More specifically, Article 158 mentions cohesion as a precondition for the harmonious development of the EU, stating the will of "*reducing disparities between the levels of development of the various regions and the backwardness of the least favored regions or islands, including rural areas*".
Following the evaluations of policies implemented at European level during the period 2000-2006 and given the objectives of the Lisbon Strategy for the programming period 2007-2013 there were established **three objectives** of the Cohesion Policy:

- "*Convergence*" Objective, for the regions with a GDP/capita below 75% of the EU average (the entire territory of Romania was placed under this objective);
- "*Regional Competitiveness and Employment*" Objective;
- "*European Territorial Cooperation*" Objective.

For the period 2007-2013, the Cohesion Policy of EU has been reformed to **better meet the objectives set in Lisbon and Gothenburg (*economy based on knowledge, research and technological development, sustainable development, employment*)**. Following this reform, the Cohesion Policy has had three tools:

- European Regional Development Fund;
- European Social Fund;
- Cohesion Fund.

The three instruments were designed to help at reducing economic development disparities between the different parts of Europe, with emphasis on knowledge and innovation, creating jobs, cooperation between regions and their transformation into attractive places to invest and work (FEHER, 2009).
The Cohesion Policy in its new form, has three objectives: **Convergence** (supporting regions lagging behind in terms of economic development), **Regional Competitiveness and Employment** (supporting regions other than those lagging behind as development level, to achieve the Lisbon Agenda targets) and **European Territorial Cooperation** (promoting a balanced development of the entire Community territory by encouraging cooperation and exchange of best practices between all EU regions).

- **"Convergence" Objective**

"Convergence" Objective was aimed at improving conditions for economic growth and for the factors contributing to a real convergence for the Member States and least developed regions.
In the European Union of 27 Member States (year 2007), this objective was referring to 84 regions situated in 17 Member States, ie 154 million people whose GDP per capita is

below 75% of the Community average. In a system of progressive suspension of aid ("*phasing out*"), this target has also included other 16 regions which numbered 16.4 million inhabitants having a GDP that had slightly exceeding the threshold as a result of statistical effect of European Union enlargement.
The amounts allocated to the objective amounted to 282.8 billion euros, representing 81.5% of the total amount distributed as follows:

- 199.3 billion euros for the regions covered by the "Convergence" Objective;
- 14 billion for the regions that are at the stage of gradual suspension of aid;
- 69.5 billion euro for the Cohesion Fund, which applies to 15 Member States.

- **"Regional Competitiveness and Employment" Objective**

"Regional Competitiveness and Employment" Objective was intended to strengthen the competitiveness and attractiveness of regions and the employability of the workforce through a dual approach. This consists of the followings:

- the introduction of development programs to help regions to anticipate and to be friendly to economic changes stimulating innovation, knowledge society, entrepreneurship and environmental protection and improving accessibility;
- increasing the number and quality of jobs by adapting the workforce.

- **"European Territorial Cooperation" Objective**

"European Territorial Cooperation" Objective was organized along three axes: cross-border cooperation, transnational cooperation and inter-regional cooperation.
This objective was designed to strengthen cross-border cooperation due to some local and regional initiatives performed jointly, to strengthen transnational cooperation through actions to promote integrated territorial development and to boost interregional cooperation, as well as exchange of experience. Over 181 million people (representing 37.5% of the total European Union population) live in cross border areas. All regions and all citizens of the Union belong to one of the 13 transnational cooperation area. The 8.7 billion euro (2.5% of the total budget dedicated to this objective) were distributed as follows:

- 6.44 billion euros for cross-border cooperation;
- 1.58 billion euros for transnational cooperation;
- 445 million euros for interregional cooperation.

The maximum co-financing coefficients for each goal were:

- Convergence: between 75% and 85%;
- Competitiveness and Employment: between 50% and 85%;
- European Territorial Cooperation: between 75% and 85%;
- Cohesion Fund: 85%.

Romania was eligible under two objectives: Convergence and European Territorial Cooperation.

The Cohesion Policy of the European Union for the period 2014-2020 aims to achieve the strategic objectives of the EU regarding "smart growth, sustainable and inclusive favorable", formulated in the document "Europe 2020- A European strategy for smart, sustainable and inclusive growth "(EUROPEAN COMMISSION, 2010).
Adopted in the year 2010, the strategy generically entitled "Europe 2020" includes the common objectives to the Member States in the view of a smart, sustainable and inclusive growth. Although launched at a time of economic crisis, the aim of the strategy was to contribute at improving the competitive position of the European Union at the horizon of

the year 2020, maintaining the model of social market economy in parallel with the efficiency of resources use.

This strategic document includes **three priorities** mutually reinforced, namely:

- *smart growth*: developing an economy based on knowledge and innovation;
- *sustainable growth*: promoting a more efficient economy in terms of resources use, more biological and more competitive;
- *inclusive favorable growth*: promoting an economy with a high rate of employment, ensuring social and territorial cohesion (*Figure 1*).

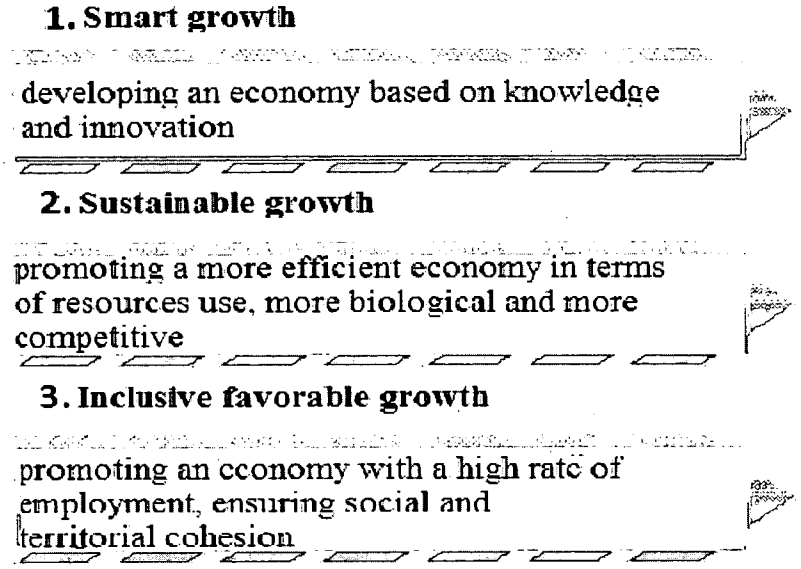

Figure 1. EU strategic objectives for the period 2014-2020

In line with these priorities there were established the following **objectives** to be achieved by the year 2020 within the European Union:

- 75% of the population aged between 20 and 64 to have a job;
- 3% of EU GDP to be invested in research- development (R-D);
- the "20/20/20" objectives in what regards climate/ energy must be met (including an emission reduction increased to 30% if there are favorable conditions in this direction);
- the share of early school leavers to be reduced below 10% level and at least 40% of the younger generation to have a tertiary degree;
- the number of people at risk of poverty to be reduced by 20 million.

The objectives set are representative for the strategic priorities of the period 2014-2020 but are not exhaustive, in the meaning that for their achievement is necessary to undertake a wide range of actions at national level, at the European Union and internationally (GOŞA et al., 2014).

To ensure that each Member State tailors the Europe 2020 Strategy to its particular situation, the Commission has proposed that these EU objectives to be translated into national targets and trajectories. In what follows, we summarized the objectives to be reached at EU level and Romania at the horizon of the year 2020 (*Table 1*):

Table 1. The objectives of Europe 2020 Strategy

	Targets of EU	Targets of Romania	Current situation in Romania
The employment rate (%)	75%	70%	63,8 %
The share of Research- Development in GDP	3%	2%	0,48 %
Targets for reducing CO_2 emissions	-20% (compared to the level of 1990)	-19% (compared to the level of 1990)	51,84 %
Renewable energy	20%	25%	22,90%
Energy efficiency, reducing energy consumption in Mtoe	368 Mtoe (20% increase in energy efficiency)	10 Mtoe (19% increase in energy efficiency)	7,3 Mtoe (16%)
Early school leaving in %	10%	11,3%	17,4 %
Tertiary education in %	40%	26,7%	21,8 %
Reduction of population at risk of poverty or social exclusion (number)	20 million	580000	240000

Source: EC Europe 2020 targets; Partnership agreement of Romania for the programming period 2014-2020

In order to contribute to the European Union strategy for smart, sustainable and inclusive growth there were formulated the following thematic objectives:

1. Strengthening research, technological development and innovation;
2. Improving the access and use, as well increasing the quality of ICT;
3. Improving the competitiveness of SMEs, the agricultural sector (for the EAFRD) and the fisheries and aquaculture sector (for the EMFF);
4. Supporting the shift towards an economy of low- carbon dioxide emissions in all sectors;
5. Promoting climate change adaptation, risk prevention and management;
6. Preserving and protecting the environment and promoting resources efficiency use;
7. Promoting sustainable transport systems and removing bottlenecks from the key network infrastructures;
8. Promoting sustainability and quality of jobs and supporting workforce mobility;
9. Promoting social inclusion, combating poverty and of all forms of discrimination;
10. Investments in education, training and vocational training for skills and lifelong learning;
11. Strengthening the institutional capacity of public authorities and stakeholders and of an efficient public administration (REGULATION (EU) NO. 1303, 2013).

For Romania to achieve the objectives of the Europe 2020 strategy, our country should meet the following challenges (MINISTRY OF EUROPEAN FUNDS, 2014):

I. Competitiveness and local development
II. People and Society
III. Infrastructure
IV. Resources
V. Administration and Governance.

For each challenge in terms of development there were selected thematic objectives to contribute at their support, as follows (*Table 2*):

Table 2. Correspondence of the thematic objectives and the development challenges from Romania

Challenge in terms of development	Thematic Objective
COMPETITIVENESS	1. Strengthening research, technological development and innovation
	2. Improving access and use and increasing the quality of ICT
	3. Improving the competitiveness of SMEs, of the agricultural sector (for the EAFRD) and of fisheries and aquaculture sector (for the EMFF)
PEOPLE AND SOCIETY	2. Improving access and use and increasing the quality of ICT
	8. Promoting sustainability and quality of jobs and supporting workforce mobility
	9. Promoting social inclusion, combating poverty and all forms of discrimination
	10. Investments in education, training and vocational training for skills
	11. Strengthening the institutional capacity of public authorities and stakeholders and of an efficient public administration
INFRASTRUCTURE	2. Improving access and use and increasing the quality of ICT
	7. Promoting sustainable transport systems and removing bottlenecks from the key network infrastructures
	9. Promoting social inclusion, combating poverty and all forms of discrimination
RESOURCES	4. Supporting the shift towards an economy of low- carbon dioxide emissions
	5. Promoting climate change adaptation, risk prevention and management
	6. Preserving and protecting the environment and promoting resources efficiency use
	7. Promoting sustainable transport systems and removing bottlenecks from the key network infrastructures
	9. Promoting social inclusion, combating poverty and all forms of discrimination
GOVERNANCE	2. Improving access and use and increasing the quality of ICT
	11. Strengthening the institutional capacity of public authorities and stakeholders and of an efficient public administration

Source: MFE Partnership Agreement of Romania for the 2014-2020 programming period

For the current programming period, Romania has been allocated a total of about 23 billion euros from the Cohesion Policy funds (10% more than during the period 2007-2013).

CONCLUSIONS

The European Union as a whole represents a key economic power globally but there can still be found large disparities between Member States, which is a major structural weakness. In this regard, the European Union has adopted a policy of economic and social cohesion aimed at achieving economic development harmonious and balanced of these, in particular by promoting the reduction of disparities in terms of development between different regions/ countries of the European Union, of the equal opportunities and sustainable development.

The regional policy has already proved its significant added value in spreading growth and prosperity across the whole Union and to address regional imbalances. At the same time, it has proven to be a dynamic policy, responding quickly and effectively to the crisis by redirecting funds towards priority areas, as well by investments in key sectors to generate economic growth and jobs.

Having a budget of 351.8 billion euros, representing about a third of the EU budget, the Cohesion Policy represents as well for the period 2014-2020 an essential component of the Multiannual Financial Framework and it is the main investment tool for achieving the objectives of the European Union.

The absorbency degree at national level of the cohesion funds in the 2007-2013 programming period in February 2015 was 64.47%, Romania being the second smallest of

EU. Thus, for the current period Romania must make greater efforts to attract these funds in order to reduce disparities between regions.

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PROPAGATION OF *TAXUS BACCATA* 'GREEN DIAMOND' BY CUTTINGS

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ABSTRACT
Buxus sempervirens and its varieties, such as 'Suffruticosa', are popular plants of historic as well as modern gardens. The box tree moth (*Cydalima perspectalis*), one of its most aggressive pests, also appeared in Hungary in 2011. *Taxus baccata* is also a species with a great tradition in historic gardens. This species has outstanding longevity, a good self-renewing capacity and is easy to handle. It can create a dense and solid surface that could serve as a green wall or an excellent background to colourful shrubs and blooming plants. The 'Green Diamond' variety of *Taxus baccata* boasting a spherical habit similar to *Buxus sempervirens* 'Suffruticosa' is a slow-grower with small, dark green leaves and would be suitable to replace 'Suffruticosa'. It tolerates pruning well and has a good renewing capacity. *Taxus baccata* 'Green Diamond' is currently propagated by grafting in Western European ornamental tree nurseries, which is however a costly and slow propagation method. As part of our work, we set the aim to work out the propagation method for *Taxus baccata* 'Green Diamond' by cuttings. As part of our work, we examined the propagation of *Taxus baccata* 'Green Diamond' by cutting in various plant growth mediums with the application of root stimulants in different concentrations.

Keywords: number of cuttings, number of roots, root length, Baltic ground peat, mixed, IBA hormone.

INTRODUCTION

The most frequent *Taxus baccata* varieties present in plant production are the following:
'Aurea' is a slow-growing variety with golden yellow shoots. Its new leaves have yellow edges and turn green again in the second year.
'Fastigiata' is a wide, columnar female variety with thick leaves standing circularly on upright branches.
'Fastigiata Aurea' is of a size similar to the previous variety. New growth is golden yellow then yellow at the edges; it is a slow-growing male variety.
'Green Diamond' is a slow-grower with a spherical habit and small, dark green leaves. It tolerates pruning well and has a good renewing capacity.
'Overeynderi' is a variety with a columnar crown when very young and turning globoid later; a male variety with upright branches.
'Nissen's Corona' is a 1-1.2 m tall cushion-shaped variety, with branches spreading on the ground then standing upright at the tips.
'Barmstedter' is a clone with dark green foliage and strong growth.
'Repandens' is a slow-growing female variety with the side branches fanning out (JÓZSA, 1993). We propagate the basic species by seed sowing. The seeds need to be layered for a year before sowing. These species can be propagated by striking in unheated plant growing facilities from August to September, and in heated greenhouses in the months of January to March (SCHMIDT AND TÓTH, 2006).
The most frequently used plant growth media are the following:
- Sand: The best is the sand dredged from the bottom of large rivers, i.e. washed river sand (SCHMIDT AND TÓTH, 1996).
- Washed and graded pearl pebble: Planting in pearl pebbles is recommended only if we can ensure high humidity by regular overhead sprinkling either automatically or manually.

SCHMIDT (1990) and KOMISZÁR (1991) recommend sand, or the 1:1 mixture of sandy peat and perlite or peat and fine gravel.

- Expanded perlite: Perlite is a rock of volcanic origin, which is expanded at a temperature of over 1000 °C after extraction and grinding. The high temperature perfectly sterilises the medium at the same time. The large grain (at least 2-5 mm in diameter) i.e. horticultural perlite is advised for striking. Being extremely light is a definite advantage (it is easy to replace) and at the same time it is perfectly sterile, airy and has a good water-retaining capacity (SCHMIDT AND TÓTH, 1996).
- Fibrous peat moss: Light brown fibrous peat moss is used for striking (Weisstorf, sphagnum peat). Peat is a slowly renewing resource when measured on a human scale (LÁNG, 2002). It has an outstandingly good water-retaining capacity once soaked, while it remains loose and airy even when saturated with water. It is strongly acidic (pH 3,5-4,5) and therefore excellent for calciphobous plants such as Rhododendrons or Erica species. For "ordinary" ornamental trees and shrubs the pH value of peat is adjusted to 6-6,5 by adding powdered lime or other admixture. Acidity hinders the spread of fungous diseases and the humic acids in the peat stimulate cuttings.

In Western-Europe, tree nurseries almost entirely use peat as rooting medium; pure in exceptional cases but the more frequently mixed with coarse sand. The mixing ratio differs from nursery to nursery as well as from plant to plant but ranges between 1:3 and 3:1. The lime content of sand is generally high enough to set the required pH value, while its weight and density improves the physical properties of the peat. We can safely strike cuttings in this mixture of peat and sand with all the possible humidifying methods. In such a medium cuttings spring rich and abundantly branching roots, and retain the medium when picked.

The heteroauxin beta-indoleacetic acid (IAA) is the most frequently used rooting chemical. In practice, the great disadvantage of this chemical is that it decomposes in light in a short while and if concentration is low, bacteria also decompose it fast. Therefore, nowadays, instead of natural auxin almost entirely its synthetically produced related chemical compounds,

- beta-indolebutyric acid (IBA), and
- alfa-naphthaleneacetic acid (NAA)

are used.

As part of our research, we examined the striking capacity of cuttings, the effect of hormone concentration, the media and cuttings quality on cuttings, callusing and cutting decay. We furthermore examined the effect of hormone concentration, the growth medium and cuttings quality on the number and length of the developed roots.

MATERIAL AND METHOD

We performed the propagation experiment under greenhouse conditions in Kovács Kertészet (Kovács Nursery) in Zalaszentgyörgy. Cuttings were planted in 104-cell nursery propagation trays. We used two types of rooting media: Baltic ground peat in 100% and the mixture of 30% Baltic peat, 30% horticultural perlite and 40% peat that can be easily obtained in the Zala region from Hahót. We treated the cuttings with alcoholic solutions of IBA hormone in three concentrations of 0.625%, 0.75% and 0.9375%, respectively. The cuttings were 6-8 cm long. We took simple and torn cuttings, and we also cut the end of the torn cuttings flat. We performed the treatments with four repetitions. We evaluated the experiment of 9 February 2013 on 24 June 2013. We counted the number of cuttings having taken root by treatment and repetition then. We removed the cuttings that had sprung root from the propagation trays. We cleared away the growth medium from the

roots of the cuttings so that we could properly determine the integrity, size and number of the developed roots. We counted the number of roots and measured their length by a measuring tape.

We divided the rooted cuttings into three categories according to the number of developed roots:

- very few (fewer than 2 pieces);
- few (between 3-5 pieces);
- multiple (more than 5 pieces).

We defined three categories according to root length too:

- short rooted cuttings (maximum 1cm);
- medium long rooted cuttings (between 1-3 cm);
- long rooted cuttings (4-5 cm).

We recorded the experimental data in an excel table. We evaluated the measurements by percentage calculation and variance analysis.

RESULTS

The effect of the growth media on the number of rooted cuttings

Based on the experiment we can state that the cuttings planted in the mixture of 30% Baltic ground peat, 30% horticultural perlite and 40% Hahót peat rooted to a larger extent irrespective of cuttings quality compared to those planted in pure Baltic peat (*Figure 1*).

The effect of hormone concentration on the number of rooted cuttings

The highest number of cuttings took root in the mixed medium with a 0.75% IBA treatment, 79 pieces in total (*Figure 2*).

In the Baltic peat medium, the highest number of cuttings rooted with a 0.625% IBA treatment, altogether 66 pieces. The cuttings treated with a 0.75% and 0.9375% IBA hormone concentration showed a significant result (*Figure 1*) in the mixed medium.

The effect of the rooting media on the number of callused cuttings

In the mixed medium the highest number of cuttings callused with the 0.9375% IBA treatment; 153 pieces in total.

In the Baltic peat medium, the highest number of cuttings callused with the 0.9375% IBA treatment; 143 pieces in total.

The effect of hormone concentration on the number of callused cuttings

Of the cuttings treated with 0.75% and 0.9375% IBA hormone concentrations, respectively, those planted in the mixed medium showed a higher number of callusing (indicative of prospective cuttings).

The effect of the rooting media on the number of developed roots

In the mixed medium and with 0.75% IBA treatment altogether 16 cuttings developed roots belonging to the highest category (more than 5 roots).

In the Baltic peat medium and with a 0.625% IBA treatment altogether 31 cuttings developed roots belonging to the highest category (more than 5 roots).

The effect of hormone concentration on the number of developed roots

The number of cuttings with more than five developed roots is the highest for cuttings treated with 0.625% and 0.75% IBA hormone concentrations (*Table 1*).

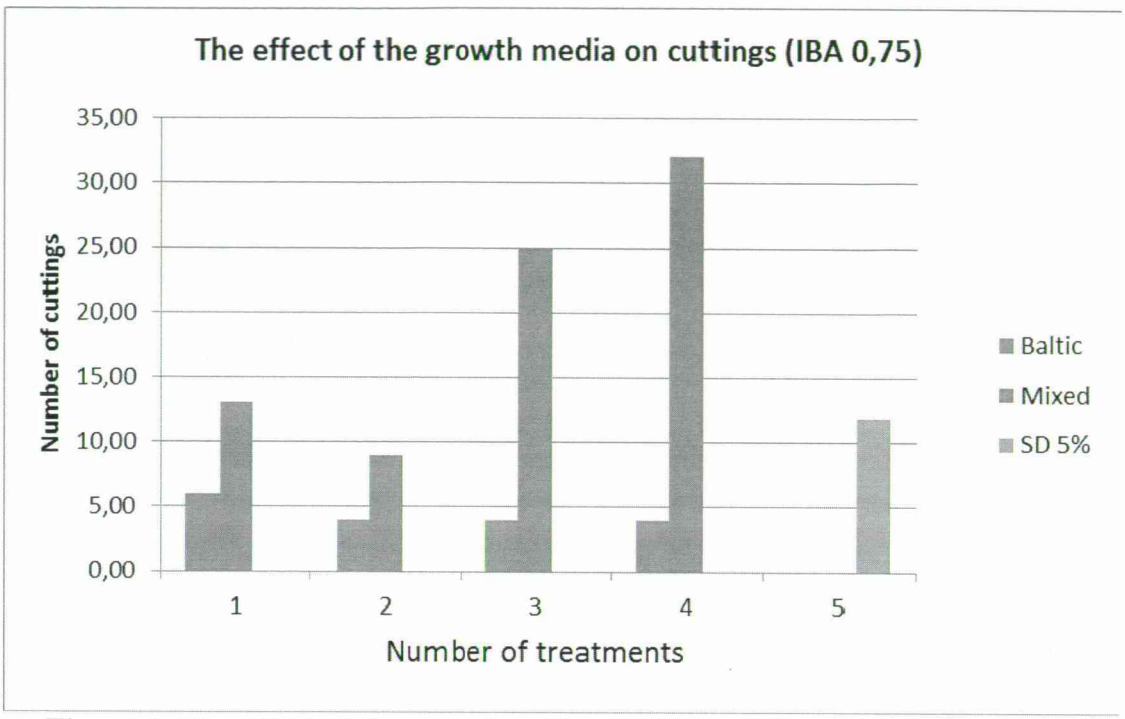

Figure 1. The effect of the growth media on the number of rooted cuttings with 0.75% IBA hormone treatment

Source: ZSUZSA TURI–FARKAS (2014)

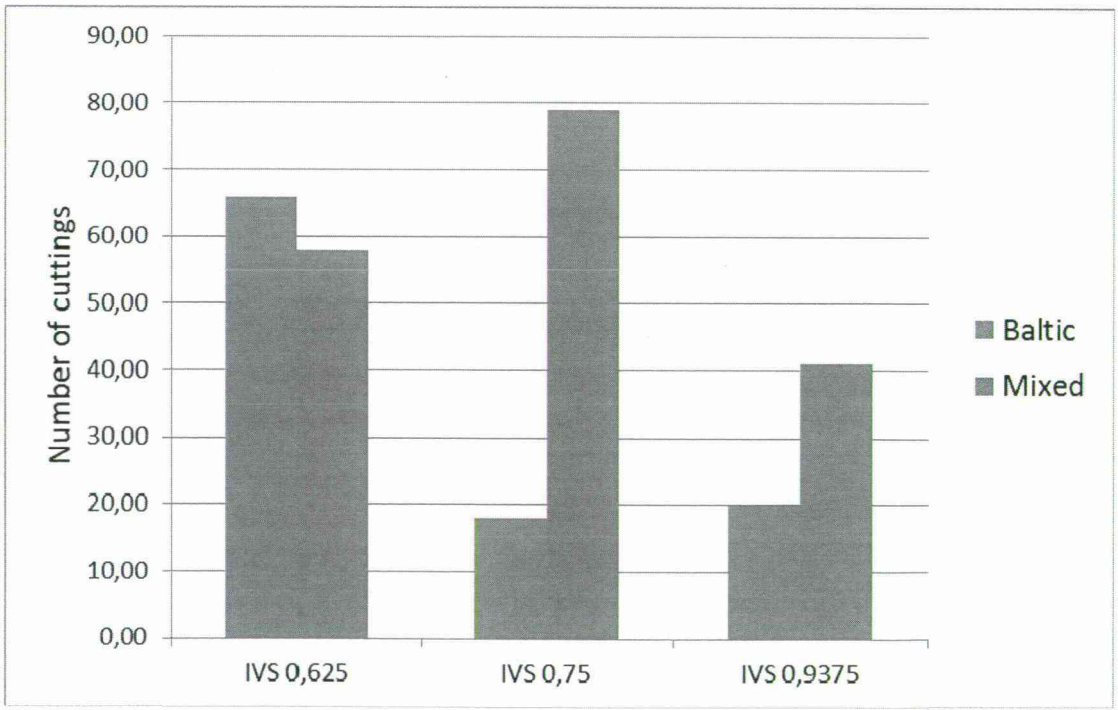

Figure 2. The effect of the medium on striking for different hormone treatments

Source: ZSUZSA TURI–FARKAS (2014)

Table 1. The number and length of the root of rooted cuttings (Mixed medium, IBA 0.625%)

Repetitions	Root length (cm)			Number of roots (pieces)		
	short 1-2 cm	medium-long 2-3 cm	long 3-5 cm	very few 2>	few 3-5	multiple 5<
1	8	4	2	8	4	2
2	12	3	0	12	2	1
3	9	3	3	9	2	4
4	10	4	0	10	3	1

Source: ZSUZSA TURI–FARKAS (2010)

The effect of the rooting media on the size of the developed roots

In the mixed medium and with 0.625% IBA treatment, altogether 5 cuttings developed roots belonging to the longest category (between 3-5 cm).

In the Baltic peat medium and with 0.625% IBA treatment, altogether 27 cuttings developed roots belonging to the longest category (between 3-5 cm).

The effect of hormone concentration on the size of the developed roots

As far as the effect on the length of the roots is concerned, the highest number of roots 3-5 cm in length developed on the cuttings treated with IBA hormone with a 0.625% concentration.

CONCLUSIONS

We can draw the following conclusions from the analysis of the results:

The significant striking and callusing relationships in the case of cuttings treated with IBA hormone in concentrations of 0.75% and 0.9375%, respectively, show a higher number for the cuttings planted in the mixed growth medium (*Figure 3*).

We can state that the cuttings planted in the mixture of 30% Baltic ground peat, 30% horticultural perlite and 40% peat from Hahót struck root and got callused to a higher extent than the ones planted in purely Baltic peat. It was the higher hormone concentration that caused a definite difference.

As far as cuttings quality is concerned, we can definitely state that stronger cuttings did not yield a large enough difference in striking to make us abandon the use of second-class cuttings. It is all the more important a statement since in this case, considering that *Taxus baccata* 'Green Diamond' is a slow-growing variety developing short joints, we can utilise the small amount of raw material suitable for propagation to the largest extent possible.

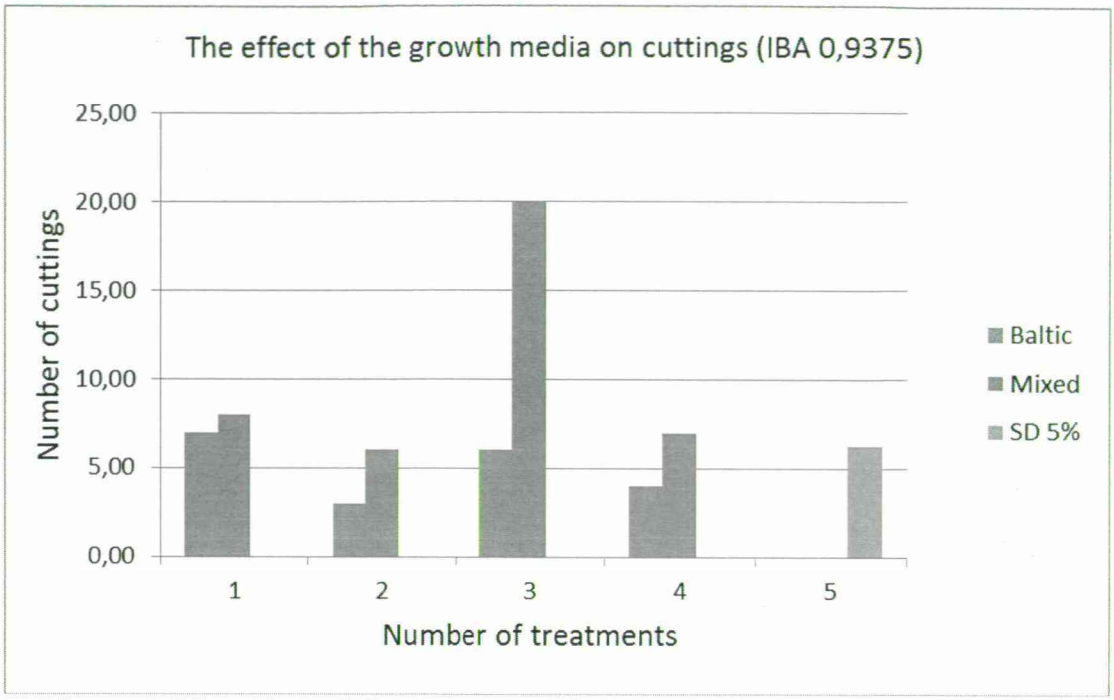

Figure 3. The effect of the growth media on the number of rooted cuttings with 0.9375% IBA hormone treatment
Source: ZSUZSA TURI–FARKAS (2014)

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THE ECONOMICS THE CORRELATION ISSUES IN EU-28

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ABSTRACT
In this case study the analyses focus on the some correlation compares among EU-28 member states. Also the analyses focus on the wide side overview for the EU-28 member states using eight variances of three principal components for EU-28. The economic growing rate of EU-28 member states concerning some economic issues as GDP growing rate, employment, unemployment accompanying with social protection and government debt, price fluctuating, purchase power parity of consumers and also probably lifelong learning. The eight numbers according to each variance give the average value of KMO, which shows in the first line of *Table 1*: KMO and Bartlett's Test, namely 0.628. In this case all of other variances expect RisPov2014 have strong correlations with themselves. The LLearn2014 has the strongest correlations by value of 0.767 (76%), also the GovDebt2014 has strong one, by 0.744 (74%), HICPan2014 has 0.731 (73%), the GDPcap2014 has value of 0.706 (70.6%). This SPSS statistical program can help to make clear overview for the correlations and differences among EU-28 member states from different issues and approaches, as variances. Also it is important, when the researchers choose these variances; they should know that the correlations among variances based on the principle components. These last one can select variances into different components, which mostly can explain the role and importance of each variance.

Keywords: Principle component, Different variances, KMO, Communalities, GDP growth

INTRODUCTION

This case-study overviews and analyses the correlations among the EU-28 and some economies by SPSS (Special Program for Social Sciences) in the EU-28 in main 8 different statistical fields, as components between 2005-2014, namely Total unemployment rate in % (UnEmploy2014); GDP and main components – volumes (GDPVol2014); HICP - inflation rate (HICP: Harmonised index of consumer prices, HICPan2014); General government gross debt (GovDebt2014); Expenditure on social protection (SocProt20v14); Lifelong learning in %, Total (LLearn2014)); People at risk of poverty or social exclusion by age and sex (RiskPov2014); Real GDP per capita, growth rate and totals (GDPCap2014; the SPSS analyses can be seen SZÉLES, 2010 and SAJTOS ET AL, 2007).

In this case study the analyses focus on some correlation compares among EU-28 member states. Also the analyses focus on the wide side overview for the EU-28 member states using eight variances of three principal components for EU-28. The economic growing rate of EU-28 member states concerning some economic issues as GDP growing rate, employment, unemployment accompanying with social protection and government debt, price fluctuating, purchase power parity of consumers and also probably lifelong learning. These analyses can clear some developing trends of EU-28 member states and other international compares within EU-28.

MATERIAL AND METHOD

The eight numbers according to each variance give the average value of KMO value, which shows in the first line of *Table 1*: KMO and Bartlett's Test, namely 0.628. Number of each variance shows how the given variance correlates with the other variances in percent, which should be more than 0,500 or it is given in percent, which is 0.628 (62.8 percent) in this example, therefore because this value is more than 50%, the correlation among variances are strong. The *Table 1*: ***KMO and Bartlett's Test*** shows that the significance is very strong as 0.000 for 28 EU member states and the significance explained by 82.330% under title of Approx. Chi-Square in the second line of the *Table 1*, by the other words this is the component matrix, which should be closed to about 85-90%, in order that the variances can be closed to each other to determine the correlations among themselves, as these are written in table of Correlation Matrix. The correlation measure of 28 EU member states based on the 8 variances is 0.628 *Tabel 1*: titled as Kaiser-Meyer-Okin Measure of Sampling Adequacy. Finally, it can be declared that the significance should be 0.000, in order that the connection can be strong among the variances in case of EU-28 member states. Otherwise if the significance is far from 0.000 and closed to 0.9 and 1 value, this means that the significance is not strong.

RESULTS

The *Table 2*: ***Anti-image Matrices for Anti-image Correlation Matrix*** shows how the each variance from eight variants is depending on the other one and how the correlations are going on among themselves. The diagonal line starts by number 0.497[a] according to the UnEmploy2005-2014 to the number 0.706[a] according to GDPcap2014. The *Table-4-4-2*: ***Anti-image Matrices for Anti-image Correlation Matrix*** the number of UnEmploy2005-2014 is 0.497, which is in 49.7 percent. If this value is less than 50%, this shows that this variable is weakly correlate with the other variances, if it is about 50%, this can enough be correlating with other variances. If the value of variance is higher than 50% as 0.500, this means strong correlation of one variance with others.

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.628
Bartlett's Test of Sphericity	Approx. Chi-Square	82.330
	df	28
	Sig.	0.000

Source: Tables are owned calculated

In this case all of other variances expect RisPov2014 have strong correlations with themselves. The LLearn2014 has the strongest correlations by value of 0.767 (76%), also the GovDebt2014 has strong one, by 0.744 (74%), HICPan2014 has 0.731 (73%), the GDPcap2014 has value of 0.706 (70.6%), SocProt2014 has value of 0.646 (64.6%) and the GDPVol2014 has enough strong correlation with others by value of 0.587 (58%). The RisPov2014 has the most weakness correlation with to the variances by 0.261 (26%). This means that if the UnEmploy2014, as unemployment decreases can be resulted by the growth of GDP volume and GDP per capita and in the same time the consuming price level (HICPan2014), the social protection (SocProt2014), life-length learning (LLearn2014) increase. Naturally the governmental debt (GovDebt2014) can increase if the

unemployment is considerable. In this case only the RisPov2014 has weak correlations with other, namely by value of 0.261 as 26.1%.

Table-2. Anti-image Matrices

Anti-image Correlation	UnEmploy 2005-2014	GDPVol 2014	HICPan 2014	GovDebt 2014	SocProt 2014	LLeran 2014	RiskPov 2014	GDPcap 2014
UnEmploy2014	**.497**[a]	.625	.080	-.247	.092	-.021	-.439	-.218
GDPVol2014	.625	**.587**[a]	-.141	-.076	.085	.013	-.379	-.234
HICPan2014	.080	-.141	**.731**[a]	-.042	.539	-.015	-.303	-.186
GovDebt2014	-.247	-.076	-.042	**.744**[a]	-.439	-.025	.158	.090
SocProt2014	.092	.085	.539	-.439	**.646**[a]	.233	-.439	-.035
LLeran2014	-.021	.013	-.015	-.025	.233	**.767**[a]	.029	-.419
RiskPov2014	-.439	-.379	-.303	.158	-.439	.029	**.268**[a]	.002
GDPcap2014	-.218	-.234	-.186	.090	-.035	-.419	.002	**.706**[a]

a. Measures of Sampling Adequacy (MSA)
Source: Tables are owned calculated

In case of the EU-28 between 2005 and 2014 when the GDPcap2014 (Real GDP per capita, growth rate and totals) and GDPVol2014 increase based on the moderate low level of unemployment, the price level and the social protection also increase, which also provides favourable conditions for continuing the study, as LLearn2014 for the population. The GovDebt2014 can increase because the governments can decrease the taxes in order that the companies will not be pressed by taxes and they can be stimulated to increase their investments to increase the performance growth, as GDP growth finally for the EU-28. The People at risk of poverty or social exclusion by age and sex (RiskPov2014) can be fixed at the earlier same level, because this trend is going on for the longer time length for the considerable fragment of the population and therefore this one is not strongly depending on the moment prosperity economic growth rate. The strongest correlation can be seen between Unemployment rate (UnEmploy2014) and GDP Volume (GDPVol2014) between 2005 and 2014 in the EU. This is the strongest correlation means that when the GDP Volume growth rate increases within the economic prosperity with increasing investment growth in performance of the EU, the Unemployment rate decreases. Also the strong correlation can be explained by mutual connection between for example the SocProt2014, namely Expenditure on social protection (SocProt2014) and HICP - inflation rate (HICP: Harmonised index of consumer prices, HICPan2014), which means that if the expenditure on social protection is growing, this last one also stimulates the consumer prices to increase. From this point of view, the purchasing power of population increases therefore the sellers and traders increase the consuming prices. Also there the strong correlation can be proofed for example between the Expenditure on social protection (SocProt2014) and the Total unemployment rate in % (UnEmploy2014) because naturally if the unemployment rate is growing up the social protection naturally increases. The social protection can provide more financial support to increase the study program and post-graduating courses for more and wider pert of the population of the society and increase the time-length of the studies (see *Table 2*).

The ***Communalities*** calculated by *Table 1* and *Table 2* shows the difference of each variance from the initial values, as 1,000 and show how the measure of each different

variance is explained by the main principal components, in this case of EU-28 three components. If the difference is not too much from the 1,000, this shows the measure of the variance is considerably explained by three principal components. If the measure of each variance is far from 1,000, for example less than half this shows how the measure of variance is not explained strongly by three principal components. Based on this calculation the Communalities have the first variance titled as RiskPov2014 was explained by three principle components by 0.839 in case of the EU-28. GDPVol2014 is the second variance titled as (GDP and main components - volumes [nama_gdp_k], 2006-2013) which has measure explained by three principle components by 0.832 value. The third variance, namely the UnEmploy2014 has the considerable measures explained by the principle components by value of 0.829, from owned calculated based on the data base of Eurostat. Probably the fourth variance as SocProt2014 (Expenditure on social protection in % of GDP between 2005 and 2013) has measure explained by value of three components as 0.786 can be seen that it has strong correlations in case of EU-28 member states.

The *other four variances* have also considerable measure explained by three principle components in case of the EU-28 member states, namely GDPcap2014 (Real GDP per capita, growth rate and totals Percentage change on previous year, Euro per inhabitant, Percentage change on previous period between 2005 and 2014) by 0.680; and HICPan2014 (HICP - inflation rate (HICP: Harmonised index of consumer prices, in Annual average rate of change %) explained by three principles components by 0.665; the LLearn2014 (Lifelong learning in %, Total in % of GDP) has importance and measure explained by three principle components by 0.658; and GovDebt2014 has measure explained by three principle components by 0.514. This last one has the weaker measure explained by the EU-28 member states against the other variances during this period of 2005-2014. Mostly all of the variances have measure explained by the principle components over the half of the 100% measure for their importance. This analyse shows that these variances have heavy importance explained by three principle components for the economic performance of the EU-28.

Total Variance Explained show that these three main components provide 72.5% of Cumulative Initial Eigenvalues of which the first THREE components. The first component has 39.9%, mostly 40.0%, the second component has 17.6% and the third components has 14.943% of Cumulative from Extraction Sums of Squared Loadings. The first three components have very considerable importance to analyse performance of EU-28 by closed to three-fourth of total variance explained in percent. The other components have less considerable measure in total variance explained in percent over first three components.

In Component Matrix in case of the *first variance* the SocPot2014 is the first variance by -0.815; the second variance the HICPan2014 by 0.787; the third variance GovDebt2014 by -0.681. In the second component the first variance RisPov2014 by 0.735; the second variance UnEmploy2014 by 0.605; the third variance GDPcap2014 by 0.539; in the third component the first variance GDPVol2014 by 0.649; the second variance RisPov2014 by 0.536; third variance UnEmploy2014 by -0.434. Within the component matrix, each component is set up by the general average of values according to eight variances by their different values in each component. In the first component first three variances, namely the SocPot2014, the second variance the HICPan2014 and the third variance GovDebt2014 have importance. But in the second component the other first three variances have importance, as RisPov2014, UnEmploy201 and GDPcap2014. In the third component

GDPVol2014, RisPov2014 and UnEmploy2014 variances have more importance than the other five variances. In case of the Component Matrix the first component has the first three most important variances, of which is one is GovDebt2014. Also the UnEmploy2014 variance has important role in the second and third components, because this is one of the first important variance of the second and third components. Therefore, the factor analyses are based on two figures, namely first Factor analyse is based on the UnEmploy2014 and GDPVol2014; the second Factor analyse is based on the UnEmploy2014 and GovDebt2014. The GDPVol2014 also has importance in the third component and this variance is one of the first three variances. The GDPVol2014 is the fourth variance of the first component by 0.641 and the first variance of the third component by 0.649. Therefore the UnEmploy2014, GDPVol2014 and GovDebt2014 variances have important role either in this Factor analyses or in the real economic performance of the EU-28. In cases of Denmark and Finland also the GovDebt2014 could make influences on the increasing the GDPcap2014, income conditions even in agricultural sector and decreasing UnEmploy2014, also the favourable economic background created by agricultural and financial policies in their economies (see ZSARNÓCZAI, 2000, p 69, and 2003, p. 72). Also the strategy and theories of the bank system and its influences on the controlling system in companies can clear direction to creating favourable economic background for companies (TOON ET AL., 2014; see also in detailed in ZÉMAN ET AL., 2014).

In ***Component Score Coefficient Matrix*** in case of the first component SocProt2014 is by value of -0.255; HICPon2014 by 0.247. In case of the second component RisPov2014 by value of 0.519; UnEmploy2014 by 0.428 and in case of the third component GDPVol2014 has value of 0.543, RiskPov2014 by 0.448, UnEmploy2014 by -0.363 and LLearn2014 by -0.347.

Table 3. Rotated Component Matrix[a]

	Component		
	1	2	3
GDPVol2014	**-.907**	.083	.078
Unemploy2014	**.838**	.388	.073
RiskPov2014	**.561**	.352	.194
GovDebt2014	.023	**.902**	-.029
SocProt2014	.341	**.800**	.032
LLeran2014	.002	-.162	**.779**
GDPcap2014	-.032	.052	**.737**
HICPan2014	-.224	-.273	**-.449**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Also there is a difficulty in case of Component matrix, that the values of the UnEmploy2014 are very high in three components, namely -0.524, 0.605 and -0.434, where the minus or plus values are not considerable difference, because in this case the absolute number or value is important. Also the values of GDPVol2014 are very high, namely 0.641 in first and 0.649 in the third components, the values of GDPcap2014 are very high as 0.604 in first and 0.539 in the second components. Also the RisPov2014 has high values as 0.735 and 0.536 in the first and second components. Therefore, the considerable similarly is among values in the same variances in case of different components, which makes difficulty for comparison.

This calculation needs for creating the other calculation under the rotation system, which can be seen in the *Table-3*: ***Rotated Component Matrix***. In this Table the GDPVol2014 is -0.907 in the first component while in other components the GDPVol2014 has less considerable values. Also it is the same in cases of UnEmploy2014 has value 0.838 and the RisPov2014 has value 0.561 in the first component more than one in the other components. The GovDebt2014 has 0.902 and SocProt2014 has 0.800 value in the second component more than in the others one. Also the LLearn2014 has 0,779 value and GDPcap2014 has 0.737 values in the third component more than in the other one. The rotated component structure makes possibility for comparing among variances of different components. It is very important that the values of variances should be different in the different other components (See *Table 3*).

CONCLUSIONS

This SPSS statistical program can help to make clear overview for the correlations and differences among EU-28 member states from different issues and approaches, as variances, like unemployment issues, GDP growth, social protection, consumer price fluctuation, lifelong learning, government debt and People at risk of poverty or social exclusion. Also it is important, when the researchers choose these variances, they should know that the correlations among variances based on the principle components. These last one can select variances into different components, which mostly can explain the role and importance of each variance.

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ANALYSIS OF AGRICULTURE IN THE WEST REGION OF ROMANIA

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ABSTRACT
The West Region has in its possession a valuable agricultural potential. The agriculture of Timiş and Arad Counties plays an important role in the overall economy of the Region, with crucial implications on living standard of the population and food security. West Region is characterized by an average size of farms greater than the national average which allows practicing a more competitive agriculture in the Region, particularly in Timiş and Arad Counties. The vegetal sector is better represented in the area than the livestock sector, its share being dominated in the production structure of agriculture branch, which creates a weaker ability to generate the additional added value through livestock production and especially by capitalizing of this in the food industry. Regarding the production structure of agriculture branch in the Region, the vegetal sector has a dominant share (67.3%) and reflects an inadequate structure without preconditions to increase the capacity of generating the additional added value through livestock production and especially through its capitalization in the food industry.

Keywords: agriculture, West Region, farm, crop area, production

INTRODUCTION

The West Development Region is located in the Western part of Romania, at the border with Hungary and Serbia, consisting by an administrative-territorial point of view of four counties: Arad, Caraș-Severin, Hunedoara and Timiș (*Figure 1*).

Figure 1. Administrative Map of the Western Region
Source: http://por.ro/index.php?page=domain&did=48

The West Region has a surface of 32,034 km2, accounting for 13.4% of the country surface. Timiş County is, by surface, the biggest in the country (3.65%) of the national territory, while Caraș-Severin County ranks third (3.65%) of the national territory, Arad County is the sixth county in Romania (3.25%) of the national territory and Hunedoara County occupies 2.96% of the national territory.

West Region comprises 42 towns (from which 12 municipalities) and 276 communes (318 administrative territorial units) grouped in the four counties.
The West Region is part of the Euroregion Danube - Kris - Mures - Tisa (DKMT), which comprises the four counties of the Western Region, three counties from Hungary and the autonomous Region of Vojvodina in Serbia. The Euroregion was established in 1997 under a cooperation protocol signed by the representatives of local authorities of the constituent regions. (The Regional Development Agency - West Region, 2015)
The population of West Region is characterized by cultural diversity (Hungarians, Germans, Serbs, Ukrainians, Roms), the Romanian communities cohabiting with the inhabiting ones.
Since the year of 1990, the population of the Region declined constantly from 2,201,717 to 1,810,604 inhabitants at 1st January 2015 (NIS, 2015), due to a negative birth rate and foreign emigration of the population in the region. The population density at 1st January 2015 was of 56.5 people/km2 in the West Region, considerably much lower than the national population density (83.3 people/km2).
The urbanization degree of the Region (61.5% urban population) is higher than the national average (53.8%) and Hunedoara County has the highest rate of urbanization in the country, after the capital, namely 74.6% urban population.
In what concerns the rural area, this is characterized demographically by a low population density, demographic decline due to migration and aging population, mortality rate being relatively high and a declining ability of demographic renewal because the natural population growth is negative (RAICOV ET AL., 2013).

MATERIAL AND METHOD

The materials that were the basis for the present work come from various sources: literature (books, articles, studies), statistic documents (Romanian Statistical Yearbook), TEMPO online database of the National Institute of Statistics.
In order to analyze the development degree of agricultural sector within the West Region, we have used the following methods of research (MILLER, 1991):

- fundamental research (basic, theoretical or academic), with the objective of acquiring new knowledge and theory development;
- applied research, oriented towards the analysis of problems and finding solutions, contributing at making decisions.

RESULTS

The agricultural potential of West Region is based on fertile agricultural lands, especially on the existence of mollisols that due to high content of humus are considered the most fertile soils for vegetal crop production. The great spread of this type of soils in the West Region and its high fertility turned Western Plain into the second largest agricultural area of the country after Bărăgan Plain. (DAVIDESCU ET AL., 2010)
The West Region has a valuable agricultural potential, comprising an agricultural area of 1,864,096 hectares by 4.9% lower than in 1990, of which 1,090,690 million hectares of arable land - 58.5%, 528,377 hectares of natural pastures – 11.3%, 210,961 hectares of natural grassland - 13.6%, 25,407 hectares of orchards and nursery trees – 1.5% and 8,661 hectares vineyards - 0.5%, which offers the possibility of practicing a complex and competitive agriculture. (NIS, 2015)

Following the evolution of land fund in the West Region for the period 1990-2014 there can be noticed that the area has decreased in all categories of use, but more pronounced decreases were found within vineyards and orchards categories (*Table 1*).

Table 1. Evolution of land fund by categories of use in West Region

Years	Total area	Agricultural area	of which, by categories of use:				
			Arable	Pasture	Meadows	Vineyards	Orchards
1990	3203317	1961074	1126721	552026	234466	11679	36182
1995	3203317	1961906	1098540	588608	232017	10562	32179
2000	3203317	1960766	1096587	590485	232406	9603	31685
2001	3203317	1960656	1097337	590065	232121	9466	31667
2002	3203317	1958610	1096745	592812	229386	8911	30756
2003	3203317	1892888	1089706	554836	211925	8715	27706
2004	3203317	1892291	1089644	554349	211978	8694	27626
2005	3203317	1891126	1088809	553383	212659	8736	27539
2006	3203317	1890124	1087784	553276	212762	8833	27469
2007	3203317	1888329	1087669	551392	213013	8831	27424
2008	3203317	1886429	1083273	554641	212537	8649	27329
2009	3203317	1886915	1090197	550236	210541	8573	27368
2010	3203317	1872375	1089780	537522	211528	8181	25364
2011	3203317	1868417	1868417	534898	211202	8400	25104
2012	3203317	1867381	1090282	532148	211235	8625	25091
2013	3203317	1866423	1091175	529864	211245	8668	25471
2014	3203317	1864096	1090690	528377	210961	8661	25407

Source: NIS, Tempo online database, B. Economic Statistics, B4. Agriculture

The agriculture of Timiș and Arad Counties plays an important role in the overall economy of the Region, with crucial implications on living standard of the population and food security.

The agricultural exploitations of Western Region using the agricultural area have an average size of 6.50 hectares per holding, compared with those at the country level that have an average area of 3.57 ha per holding. It notes the fact that the average size per farm is higher in the West Region than for the whole country.

As in all the country, within the West Region as well there is widely practiced a subsistence agriculture, nonperforming for self-consumption. The lack of association and poor technical equipment of subsistence holdings do not allow practicing an efficient and competitive agriculture. Individual farms (of subsistence) represent 98.4% of total holdings at regional level, with an average area of 2.87 ha and is working 43.8% of total agricultural area.

There can be seen a new emerging category of agricultural exploitations, arranged as self-employed person (SEP), individual enterprise (IE) or family business (FB). These account of 314 in the West Region, comprising a very small share of the total exploitations of only 0.1%, but these holdings are on average of medium size of about 50 ha, family farm generating of income to family members in the West-European meaning.

Holdings with legal personality (agricultural associations, agricultural societies, enterprises, companies etc.) that have a profound commercial character, with the main goal to obtain profit hold only 1.5% of total holdings in the West Region, but hold over 55% of the agricultural area of the Region.

By analyzing as evolving the situation of agricultural exploitations in Timiș County, there can be mentioned an improvement in this respect. Compared to the year 2007 when there was a structural survey in agriculture, the share of individual subsistence farms decreased from 99.3% in the year 2007 to 98.4% in the year 2010, the agricultural area related to these, decreasing too, from 56.5% of total agricultural area, to 43.8%. There can be noticed a trend

of lands consolidation. The family farms in the true sense of the word begin to appear as well, but for now their share is very small (HURMUZACHE ET AL., 2014; SÎRBULESCU ET AL., 2008). The commercial farms, with legal personality have increased, their share of total exploitations increasing from 0.7% as it was in 2007 to 1.5% in 2010, and the agricultural area used by these increased from 43.3% to 55.3%.

The legal status of agricultural exploitations in the West Region is shown in *Table 2*, compared with the national situation. At almost all categories of holdings there can be seen the superiority of average size at exploitations in the West side of the country than that recorded nationally (NIS, 2012, 2015).

Table 2. Agricultural exploitations from the West Region compared to Romania, by legal status

Specification	Agricultural holdings number		Used agricultural area ha		Average area ha / holding	
	West Reg.	Romania	West Reg.	Romania	West Reg.	Romania
A. Agricultural holdings without legal personality:	**269727**	**3828345**	**774304**	**7449621**	**2.87**	**1.95**
- Individual agr. holding	269413	3823130	758960	7151186	2.81	1.87
- SEP, IE, FB*	314	5215	15343	298435	48.86	57.23
B Agricultural holdings with legal personality:	**4164**	**30698**	**957110**	**5856506**	**229.85**	**190.78**
- Societies/ agr. associations	137	1381	71174	550878	519.51	398.90
- Companies	2470	16500	463319	3171130	187.57	192.18
- Public administration units	319	3313	363161	1669337	1138.43	503.87
- Cooperative units	5	68	10	8166	2.00	120.24
- Other types**	1197	9436	59444	456984	49.66	48.43
Total	**273891**	**3859043**	**1731414**	**13306128**	**6.50**	**3.57**

*SEP – self-employed person; IE – individual enterprise; FB – family business

** Autonomous administrations, institutes and research stations, school units of agricultural profile, local councils and municipalities, other public institutions

Source: NIS, Farm Structure Survey in 2010

In order to analyze agricultural production it is necessary to analyze crop production, the evolution of cultivated areas with different cultures. From the data of *Table 3* there can be noticed that during 1990-2014 the total cultivated area in the Western Region was reduced from 1,106,007 ha in 1990 to 907,783 in 2014, thus 17.9%. The biggest decrease of the cropped area is recorded at sugar beet crop from 20,996 ha in 1990 to 3,084 ha in 2014, with 85.3% and at the culture of barley from 97,013 ha in 1990 to 39,969 in 2014, with 58.8%.

Table 3. Evolution of the cultivated area in the West Region (ha)

Years	Agr. area	Total cultivated area	Cereals grains	of which:			Oil plants	Sugar beet	Potatoes	Vegetables
				Wheat and rye	Barley	Grain maize				
1990	1961074	1106007	675392	256532	97013	294018	88372	20996	31522	27730
1995	1961906	1083861	803680	333408	113087	310567	77727	15247	25563	26684
2000	1960766	879705	639042	190384	70805	336347	72345	3123	28168	29859
2002	1960656	1004088	708117	223598	86557	352268	85630	3614	31325	32331
2004	1958610	973373	795589	303847	77128	356357	85135	957	29895	28994
2005	1892888	908639	677994	264202	71580	301082	79271	2395	31594	29255
2006	1892291	851934	614103	233751	60903	282335	98615	2464	31203	32638
2007	1891126	765327	550619	226835	33112	261633	93706	461	29422	29837
2008	1890124	789867	578529	207445	43306	285506	79704	643	29173	33935
2009	1888329	779853	588357	215764	43510	288660	59835	641	31002	30582
2010	1886429	761427	555902	219902	33339	265066	82796	562	30562	29182
2011	1886915	842719	633570	204247	31668	350511	87007	790	26058	30622
2012	1872375	836810	628399	187383	21606	372183	83266	2436	25798	30416
2013	1868417	872392	646593	223314	48131	335545	112644	2291	20113	32672
2014	1867381	907783	675524	242396	39969	347521	116024	3084	20113	32672

Source: NIS, Tempo online database, B. Economic Statistics, B4. Agriculture

There must be noted, however, that the downward trend of cultivated areas was recorded until the year 2010, after that year following an increase of the cultivated area in the Western Region, both in total cultivated area and in most cultures (*Figure 1*) while the agricultural area is continuously decreasing. This positive trend can be explained in terms of increasing of direct payments to farmers under the provisions of the Common Agricultural Policy, which encourages cultivation of agricultural lands. The trend is similar to the one recorded at national level (*Figure 2*).

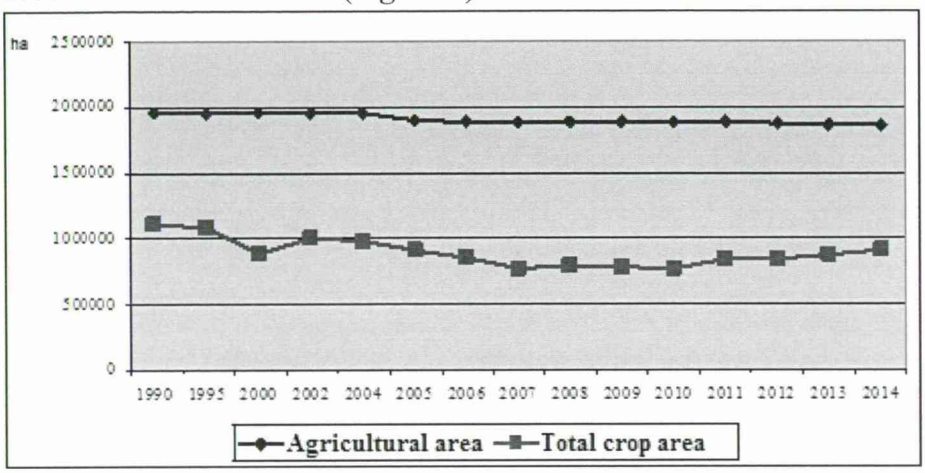

Figure 1. Evolution of agricultural and cultivated area in West Region

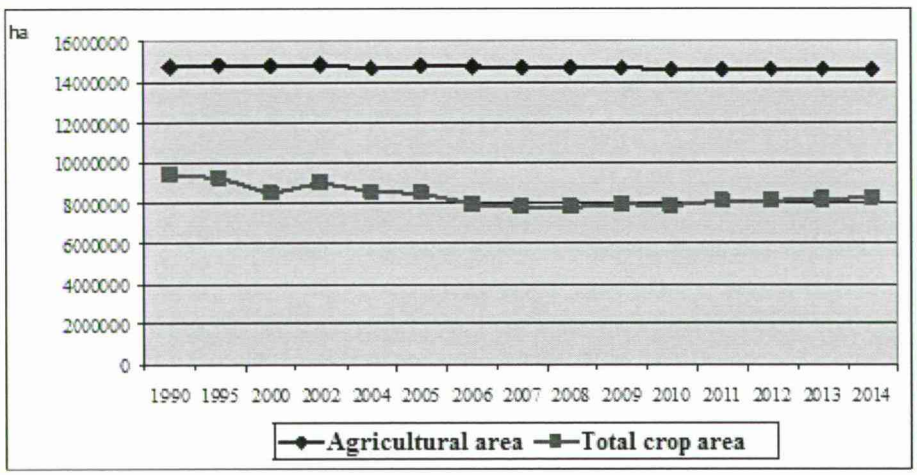

Figure 2. Evolution of agricultural and cultivated area nationally

During the analyzed period the crop production had a fluctuated evolution (*Table 4*), being closely linked to climatic variations and financial support policies either from the state budget before accession or public funds (Community direct payments and payments from state budget) after accession (GOŞA ET AL., 2012). The support was directed in particular towards certain structures of production (cereals, oily plants), which recorded production increases. This situation has resulted in a surplus of production, which in some periods caused major imbalances in the market, yields being unable to properly capitalize and the obtained prices from the sale of production were in most cases below the achieved production costs. With the entry into the European Union there have occurred as well the direct payments per hectare and six complementary national direct payment schemes in the vegetal sector. A culture concerned was the sugar beet too, that after the year 2010 we are witnessing an increase of cultivated area and production obtained.

Table 4. Evolution of agricultural production for the main crops in West Region (tons)

Years	Cereals grains	of which:			Sunflower	Sugar beet	Potatoes
		Wheat and rye	Barley	Grain maize			
1990	1898296	844482	324067	681585	58179	452210	250749
1995	2572460	1093402	350618	1048875	97309	280342	341427
2000	1371037	477006	164026	674565	48327	27188	323729
2002	2197962	662345	220790	1240311	116932	73843	463611
2004	3390057	1215472	295811	1761420	116583	44587	483774
2005	2409259	856398	193700	1286170	107478	80659	452367
2006	2135544	724123	160638	1181660	102297	72240	457109
2007	1432659	619738	77022	690963	65570	6104	418850
2008	1982138	713104	137825	1024627	95038	24490	406510
2009	1807342	604868	115762	1009614	83692	23381	460621
2010	2034390	657679	82121	1208001	90413	25211	378801
2011	2648659	822601	124363	1570345	114047	39365	366713
2012	1992148	726488	75193	1075699	128957	73901	309132
2013	2683449	968303	192439	1409572	214830	78088	278196
2014	2891097	970499	147547	1637253	243919	166823	272748

Source: NIS, Tempo online database, B. Economic Statistics, B4. Agriculture

The average yield for main crops (*Table 5*) in the Region is above the average at country level.

Table 5. Average yield of main crops (kg/ha)

Culture	2012	2013	2014	2012	2013	2014
	West Region			Romania		
Wheat	3878	4342	4005	2652	3468	3590
Barley	3480	3998	3692	2325	3011	3319
Oats	2109	2485	2641	1743	2051	2124
Grain maize	2890	4201	4711	2180	4488	4770
Grain peas	1099	1418	1422	1572	1719	1864
Grain beans	1036	1072	1255	848	1233	1252
Sunflower	1743	2387	2973	1310	1993	2187
Soybean	1462	1304	2352	1308	2216	2539
Sugar beet	30337	34085	54093	26363	36569	44711
Potatoes	11699	13567	14196	10777	15953	17527
Tomatoes	12022	14055	13386	13761	15488	16102
Dry onion	10702	12962	15142	10449	12152	12770

Source: NIS, Tempo online database, B. Economic Statistics, B4. Agriculture

Livestock in the West Region are below the national average and are in continuously decreasing from 1990 to 2009 in all species, then recording an increasing trend, except in the case of cattle (*Table 6*). These reductions of livestock were driven by low recovery of plant resources, particularly of pastures and meadows, but also by reducing cereals production and of secondary production, due to the large fluctuations in yields. In the same time, the sharp declines of livestock were the result of reducing the capacity of cutting and processing meat. The existence of a large number of livestock on small households, distributed in small number per household characterize the excessive pulverization of livestock destined to self consumption, the quantities for the domestic market being reduced compared to necessity.

Table 6. Evolution of livestock in the Western Region (heads)

Years	Cattle	Pigs	Sheep	Goats
1990	535900	2119500	1569900	85571
1995	314665	1233435	1166554	57849
2000	250170	638010	957579	41311
2002	239050	610676	927567	38560
2004	218478	747080	1044387	29260
2005	225275	772193	1047559	29186
2006	237912	946187	1078478	32080
2007	221939	968022	1136577	47182
2008	207235	931416	1143286	48074
2009	184915	919125	1203825	50484
2010	152492	925307	1269939	53127
2011	143747	932341	1261277	54928
2012	152965	955530	1335866	56232
2013	153660	971672	1426156	62725
2014	157409	945804	1431202	67274

Source: NIS, Tempo online database, B. Economic Statistics, B4. Agriculture

In the livestock breeding sector the diminishing of livestock resulted also in the decrease of total yields for meat, eggs and wool, decreases that could not be offset by the increased average yields. The exception is the total evolution of herds and milk production. It can be seen that (*Table 7*) West Region is specialized in the production of pork meat (we mention in this regard the Smithfield Complex which is present in all counties of the Region), pork meat production accounting for 26.75% of national production.

Table 7. Farm Animal Production in the Western Region (2013)

	West Reg.	Romania	% West Reg. of RO
Meat - total (tonnes live weight)	200568	1332000	15.05
Beef meat (tonnes live weight)	13675	198000	6.90
Pork meat (tonnes live weight)	148467	555000	26.75
Sheep and goats meat (tonnes live weight)	12000	107000	11.21
Poultry meat (tonnes live weight)	26382	471000	5.60
Milk - total (thousands hl)	4000	48337	8.27
Cow and buffalo milk (thousand hl)	3337	42036	7.93
Wool - total (tonnes)	2818	19713	14.29
Extracted honey (tonnes)	4018	23062	17.42
Eggs Total (million pieces)	533	6398	8.33

Source: NIS, Tempo online database

In what regards the structure of agricultural production, which in fact represents the expression of a balanced development of this economic branch, we consider the share of vegetal yield of 67.3% of the total agricultural yield in the West Region which reflects an inadequate structure, with no preconditions of increasing the capacity of generating the additional added value through livestock yield and particularly through its capitalization in food industry. In fact, the low livestock herds are influencing negatively both the level and price of vegetal yield.

West Region achieved in the year 2013 an agricultural production of agricultural goods and services accounting of 1,986,437 thsd euros, representing 11.2% of agricultural production of the country (17,756,147 thsd euros).

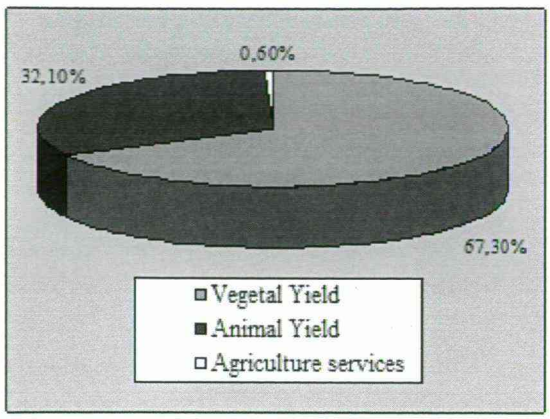

Figure 3. The structure of agricultural branch production in West Region

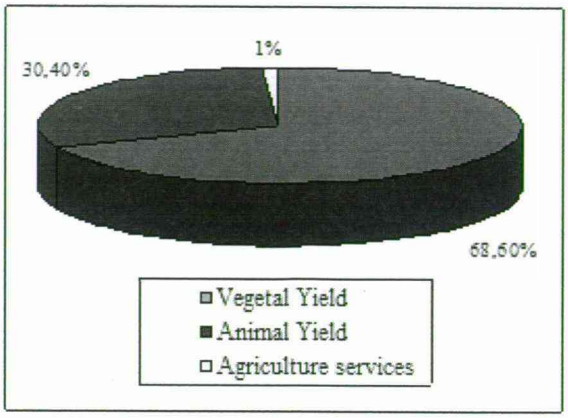

Figure 4. The structure of agricultural branch production in Romania

In the year 2013 crop production in the West Region accounted for 67.3%, while livestock production accounted for 32.1% of total agricultural production. The share of animal production is slightly higher than the national average, which is encouraging (*Figure 3*).
As structure for the analyzed years, there can be noticed small fluctuations of amending the share of the two sectors, vegetal and animal, the vegetal sector dominates much both in the Region and nationally (*Figure 4*).

CONCLUSIONS

- The agricultural potential of West Region is based on fertile agricultural lands, especially on the existence mollisols which are, due to their high content of humus, the most fertile soils for crop production.
- The agricultural area of the Western Region decreased during the study period 1990-2014 in all categories of use, but more pronounced decreases were found in categories of vineyards and orchards.
- The agriculture of Timis and Arad Counties has an important role in the overall economy of the region, with crucial implications on living standard of the population and food security.
- The average size per exploitation is higher than in the West Region than in whole country (6.50 ha/farm in West Region and 3.57 ha/farm nationally).
- Both nationally and in the West Region there is still widely practiced a subsistence agriculture, underperforming for self-consumption. The lack of association and poor technical equipment within the subsistence holdings do not allow practicing an efficient and competitive agriculture.
- Individual agricultural holdings (of subsistence) represent 98.4% of total holdings at regional level, with an average area of 2.87 ha and is working to 43.8% of total agricultural area.
- We note that after he year 2010 an increasing trend of crop area that can be explained in terms of increasing direct payments to farmers under the provisions of the Common Agricultural Policy, which encourages cultivation of agricultural lands.

- Vegetal production presents a fluctuated evolution, being closely linked to climatic variations and financial support policies either from the state budget before the accession or public funds (Community direct payments and payments from the state budget) after the accession.
- The average yield for main crops in the region is above the average at country level.
- Livestock in West Region are below the national average due to poor vegetal resources recovery, particularly of pastures and meadows, but also to reducing grain production and of secondary production, due to the large fluctuations in crop yields.

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IMPLEMENTATION OF COMMON AGRICULTURAL POLICY PROVISIONS ON DIRECT PAYMENTS. CASE STUDY ROMANIA

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ABSTRACT
The concept of "common policy" faithfully reflects one of the defining features of the Common Agricultural Policy. Currently, CAP is built around two pillars: Pillar I- Agriculture and Pillar II- Rural Development. The main way to support agriculture is represented by direct payments. The Regulation (EU) 1307/2013 establishing rules for direct payments to farmers during the programming period 2014-2020 provides uniform payment schemes applicable in all Member States. Some of these schemes are compulsory (such as basic payment scheme or single payment area; payment scheme for farmers using agricultural practices beneficial for the climate and environment), others are optional, leaving it to countries if they want to apply these schemes or not.
The proposals for payment schemes applicable in Romania during the period 2015-2020 are: Single Area Payment Scheme (SAPS); Payments for Agricultural Practices Beneficial for the Climate and the Environment; Redistributive Payment; Payments for Young Farmers; Transitional National Aids and Simplified Scheme for Small Farmers.

Keywords: CAP, direct payments, strategy, economic growth

INTRODUCTION

For the rich countries of the world food security was and still it is a national priority that stimulated different methods of agricultural support and farmers protection. Within the European Economic Community, shortly after the signing of the Treaties of Rome in the year 1957 took place the Conference of Stress (1958) which, analyzing the state of agriculture in member countries of EEC, established a common strategy for the development of agriculture recorded, a few years later, within the Common Agricultural Policy (CAP) valid today as well, obviously, in a form adapted to current conditions in the European Union. (FEHER, 2009; GOŞA et al., 2014)
The provisions of the European Commission regarding the Common Agricultural Policy for the programming period 2014-2020 are in line with Europe 2020 Strategy, where is stipulating that in the future the economic growth in the European Union should be smart (based on knowledge and innovation), sustainable (according to the long term needs of the planet) and inclusive (beneficial to the whole society) (EUROPEAN COMMISSION, 2010).
Adopted in the year 2010, the strategy generically entitled "Europe 2020" includes the common objectives of the Member States in the view of a smart, sustainable and inclusive growth. Although launched at a time of economic crisis, the aim of the strategy was to contribute at improving the competitive position of the European Union at the horizon of the year 2020, maintaining the model of social market economy in parallel with the efficiency of resources use. In line with these priorities there were established the following objectives to be achieved by the horizon of the year 2020 at European Union level regarding the Common Agricultural Policy (*Figure 1*)(EUROPEAN COMMISSION, 2010):

Objective no 1: Viable food production

• to contribute at farm incomes and to limit their variability, given the prices and incomes volatility, as well the natural risks are more pronounced than in most other sectors and the incomes and profitability levels of farmers, are on average, lower than the rest of the economy;

• to improve competitiveness within agricultural sector and to increase the share of its value in the food chain, due to the fact that the agricultural sector is highly fragmented compared to other sectors of the food chain which are better organized and have therefore a higher bargaining power. In addition, European farmers are facing competition on the world market, they must also meet the high standards demanded by European citizens, in relation to environmental condition, food safety, food quality and animal welfare;

Objective no 2: Sustainable management of natural resources and climate policies

• to guarantee sustainable production practices and to ensure the improved provision of environmental public goods as many of the public benefits generated by agriculture are not remunerated through the normal functioning of markets;

• to encourage green growth through innovation which requires adopting new technologies, developing new products, changing production processes, and supporting new patterns of demand, especially in the context of the emerging bioeconomy;

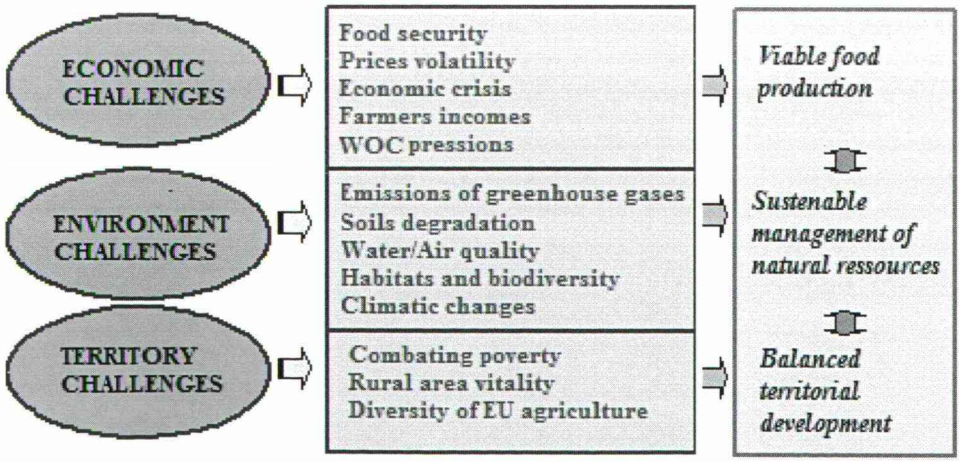
• to move to actions of climate changes mitigation and of adaptation at these, allowing agriculture to respond to climate changes. Due to the fact that agriculture is particularly vulnerable to the impact of climate changes, by creating the needed conditions for the sector to better adapt to the effects of extreme weather fluctuations there can reduce the negative effects of climate changes as well.

Objective no 3: Balanced territorial development

• to support employment in rural areas and to preserve the social structure of rural areas;

• to improve rural economy and to promote diversification, in order to allow the local level to develop their potential and to optimize the use of additional local resources;

• to allow structural diversity of farming systems, to improve the conditions for small farms and to develop local markets, for agricultural structures and heterogeneous production systems to contribute at the attractiveness and identity of rural regions of Europe.



Source: Processing based on "The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future", Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 2010

Figure 1. The objectives of the Common Agricultural Policy for the period 2014-2020

The European Commission has released the draft regulations package of the new Common Agricultural Policy in the European Parliament on 12th October 2011. With their presentation in the European Parliament, they have become the object of public debate, following by the end of 2013 the approval procedure and regulation of projects within the competent European bodies.

In December 2013 the European Commission has published the Regulations representing the legislative Package regarding Common Agricultural Policy for the period 2014-2020, namely:

- European Parliament Regulation (EU) no. 1305/2013 and Council Regulation of 17th December 2013 related to the support for rural development granted by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) no. 1698/2005;
- European Parliament Regulation (EU) no. 1306/2013 and of the Council Regulation of 17th December 2013 on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) no. 352/78, (EC) no. 165/94, (EC) no. 2799/98, (EC) no. 814/2000, (EC) no. 1290/2005 and (EC) no. 485/2008;
- European Parliament Regulation (EU) no. 1307/2013 and Council Regulation of 17th December 2013 of establishing certain rules regarding the direct payments to farmers under support schemes within the Common Agricultural Policy and repealing Council Regulation (EC) no. 637/2008 and Council Regulation (EC) no. 73/2009;
- European Parliament Regulation (EU) no. 1310/2013 and Council Regulation of 17th December 2013 establishing certain transitional provisions related to the support for rural development granted by the European Agricultural Fund for Rural Development (EAFRD) and repealing European Parliament Regulation (EU) no. 1305/2013 and Council Regulation in what concerns the resources and their distribution for the year 2014, repealing Council Regulation (EC) no. 73/2009 and European Parliament Regulations (EU) no. 1307/2013, (EU) no. 1306/2013 and (EU) no. 1308/2013 and Council Regulations in terms of their implementation in the year 2014.

Regarding the Common Agricultural Policy, the European Commission provisions aim at preserving the two pillars architecture of the CAP with a budget for agriculture comparable to the level as in the previous programming period, a mechanism regarding direct payments redistribution between Member States and restructuring market measures. It is intended the Common Agricultural Policy to support sustainable agricultural activity in Europe by improving its competitiveness, by ensuring a proper supply and secure food provision, by preserving the environment and rural space while providing in the same time a fair standard of living for the agricultural community. "As such, it replaces the 27 different national agriculture policies and represents virtually "savings" for national budgets due to the fact that the direct support to farmers is provided through the EU budget without the need for national co-financing. It notes that the new CAP should lead to a more right and equitable system of support across the whole EU, by linking agriculture with the environment policy in the sustainable management of rural space and by ensuring of the fact that agriculture continues to contribute to a dynamic rural economy" (EUROPEAN COMMISSION, 2010).

MATERIAL AND METHOD

The materials that were the basis for the present research were taken from official documents (EU and national legislation in the field, reports, press releases), statistical documents (Romanian Statistical Yearbook, Statistical Yearbook of the European Union Eurostat - both available as well online) and data obtained within the research from

database of certain public institutions (we mention here Ministry of Agriculture and Rural Development and the Agency for Payments and Intervention in Agriculture). The methods used were analysis, synthesis, comparison method, deduction and induction.

RESULTS

Through the new financial package there are mainly allocated the financial resources to support CAP for the budget cycle 2014-2020:
1) € 296.0 billion for Pillar I (EU Regulation no. 1307 and no. 1310 of 17th December 2013 on Direct Payments);
2) € 95.7 billion for Pillar II (EU Regulation no. 1306 of 17th December 2013 on the support for rural development).
The allocations for direct payments to Member States in the form of national net ceilings, are presented in *Table 1*.

Table 1. Annual national ceilings for direct payments

Member countries	Annual national ceiling (millions €)				
	2015	2016	2017	2018	2019-2020
Austria	693.1	692.4	691.8	691.7	691.7
Belgium	536.1	528.1	520.2	512.7	505.3
Denmark	916.6	907.1	897.6	889.0	880.4
Finland	523.3	533.4	523.5	524.1	524.6
France	7553.7	7521.1	7488.4	7462.8	7437.2
Germany	5144.3	5110.4	5076.5	5047.5	5018.4
Greece	2039.1	2015.1	1991.1	1969.1	1947.2
Ireland	1215.0	1213.5	1211.9	1211.5	1211.1
Italy	3902.0	3850.8	3799.5	3751.9	3704.3
Luxemburg	33.6	33.5	33.5	33.5	33.4
Netherlands	780.8	768.3	755.9	744.1	732.4
Portugal	566.0	574.1	582.2	590.9	599.5
United Kingdom	3555.9	3563.3	3570.5	3581.1	3591.7
Spain	4842.7	4851.7	4866.7	4880.0	4893.4
Sweden	696.9	697.3	697.7	698.7	699.8
Total EU-15	**33247.9**	**33108.9**	**32955.7**	**32837.5**	**32719.2**
Bulgaria	721.2	792.4	793.2	794.8	796.3
Czech	874.5	873.7	872.8	872.8	872.8
Cyprus	50.8	50.2	49.7	49.2	48.6
Croatia	130.6	149.2	186.5	223.8	261.1
Estonia	121.9	133.7	145.5	157.4	169.4
Latvia	195.6	222.4	249.0	275.9	302.8
Lithuania	417.9	442.5	467.1	492.0	517.0
Malta	5.0	4.9	4.9	4.8	4.7
Poland	2987.3	3004.5	3021.6	3041.6	3061.5
Romania	**1629.9**	**1813.8**	**1842.4**	**1872.8**	**1903.2**
Slovakia	380.7	383.9	387.2	390.8	394.4
Slovenia	138.0	137.0	136.0	135.1	134.3
Hungary	1271.6	1270.4	1269.2	1269.2	1269.2
Total EU-13	**8927.5**	**9281.4**	**9427.7**	**9582.8**	**9737.9**
Total EU-28	**42175.4**	**42390.3**	**42383.4**	**42420.3**	**42457.1**

Source: Regulation (EU) no. 1307 Annex III and Regulation (EU) no. 1310 Annex II 2013

Based on the data presented, it results that in the year 2017 the maximum ceiling allocated annually is achieved for each Member State. It notes also the decrease of annual ceilings for a group of states (generally the old member states of EU) and the increase of annual ceilings for the group of new member countries of EU.
Comparing national ceilings on the utilized agricultural area of each Member State, the amplitude of differences (inequalities) is even more obvious (*Table 2*).

Table 2. The situation of national ceilings (mil. €) and direct payments per UAA (€/ ha)

Country	UAA (thsd ha)	2015		2019-2020	
		Nat. ceiling (mil. €)	€/ ha UAA	Nat. ceiling (mil. €)	€/ ha UAA
Austria	2727	693.1	254	691.7	254
Belgium	1308	536.1	410	505.3	386
Denmark	2619	916.6	350	880.4	336
Finland	2258	523.3	232	524.6	232
France	27739	7553.7	272	7437.2	268
Germany	16699	5144.3	308	5018.4	301
Greece	4857	2227	459	2135	440
Ireland	4959	1215	245	1211.1	244
Italy	12098	3902	323	3704.3	306
Luxemburg	131	33.6	256	33.4	255
Netherlands	1848	780.8	423	732.4	396
Portugal	3642	566	155	599.5	165
United Kingdom	17096	3555.9	208	3591.7	210
Spain	23300	4903.6	210	4954.4	213
Sweden	3029	696.9	230	699.8	231
TOTAL EU-15	**124310**	**33247.9**	**267**	**32719.2**	**263**
Bulgaria	4651	723.6	156	798.9	172
Czech	3491	874.5	251	872.8	250
Cyprus	109	50.8	466	48.6	446
Croatia	1571	130.6	83	261.1	166
Estonia	957	121.9	127	169.4	177
Latvia	1878	195.6	104	302.8	161
Lithuania	2861	417.9	146	517	181
Malta	11	5.1	464	4.7	427
Poland	14410	2987.3	207	3061.5	212
Romania	**13056**	**1629.9**	125	**1903.2**	146
Slovakia	1902	380.7	200	394.4	207
Slovenia	485	138	285	134.3	277
Hungary	4656	1271.6	273	1269.2	273
TOTAL EU-13	**50038**	**8927.5**	**178**	**9737.9**	**195**
TOTAL EU-28	**174348**	**42175.4**	**242**	**42457.1**	**244**

Source: Own calculations based on Regulation (EU) no. 1307 Annex III, and Eurostat for UAA 2013

From the table and the chart from below (*Figure 2*) there are noted significant differences in terms of support per hectare due to each Member State. The differences are maintained

due to the use of historical references (yields per hectare during the period 2000-2002) which further generates major imbalances, unfair competition or discrimination, with obvious negative effects, unbearable by the poorer countries of the European Union as it is Romania too.

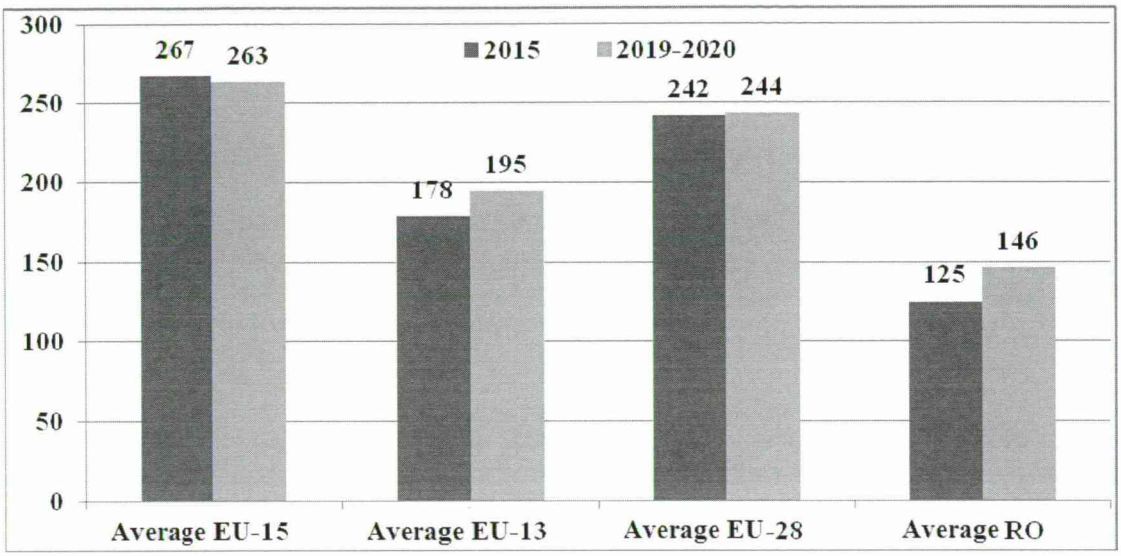


Figure 2. Support for direct payments relative to UAA in the years 2015 and 2019-2020 (Euro/ha)

The largest subsidies will receive farmers from Cyprus, Greece and Netherlands, and the lowest subsidies will receive the first farmers from Romania, Latvia and Croatia.

Since 2015, according to Regulation (EU) no. 1307/2013, GO no. 3/2015, MARD Order no. 619/2015 and MARD Order no. 620/2015 of establishing rules related to direct payments granted to farmers, payment schemes that can be accessed by Romanian farmers are the followings:

- Single Area Payment Scheme;
- Transitional National Aid – TNA;
- Redistributive Payment;
- Payment for agricultural practices beneficial for the climate and the environment;
- Payment for young farmers;
- Coupled support scheme;
- Simplified scheme for small farmers.

The financial support will be granted only to active farmers, natural or legal persons or groups of natural or legal persons who can prove legal right to use the holding and are carrying in their farms an agricultural activity – are cultivating land or livestock, are maintaining the agricultural area by usual technologies under suitable conditions for grazing or cultivation or performing minimal activities on agricultural areas typically kept in a state suitable for grazing or cultivation.

The farmers who in the year prior to payment have received direct payments not exceeding the amount of EUR 5,000 are considered active farmers. To the list of exclusions from payments imposed at EU level, Romania proposed to include some businesses or similar non-agricultural activities- enterprises/ construction companies, National Forest, managers of private forests, prisons, UAT (villages, cities, towns, counties).

In the case when beneficiaries in the year prior to payment have received direct payments exceeding the amount of 5,000 euro and are found on the list of exclusions from payments, they can become active farmers if they prove that the agricultural activity carried on their exploitation represents their main activity, as follows:

- annual amount of direct payments is less than 5% of its total revenue derived from non-agricultural activities in the most recent fiscal year for which such evidence is available, or
- total revenues within the exploitation derived from agricultural activities represent at least one third of the total revenue in the latest fiscal year for which such evidence is available;

Ministry of Agriculture and Rural Development is the competent authority that manages European Union funds for agriculture and rural development, namely the European Agricultural Guarantee Fund (EAGF), being in line with the annual ceilings and budgetary commitments, agreements or agreed between the European Commission and the Romanian Government, as well as funds from the national budget.

Agency for Payments and Intervention in Agriculture is the institution responsible for the implementation of direct payment schemes for agriculture, having as financing source the European Agricultural Guarantee Fund (EAGF).

To benefit of granting direct payments, farmers must be enrolled in the Unique Register of Identification managed by APIA, to submit the single application for payment on time and to meet the following general conditions:

- to exploit an agricultural land with an area of at least 1 ha, the agricultural parcel area to be at least 0.3 ha and if greenhouses, solariums, vineyards, orchards, hops crops, nurseries, shrubs, the agriculture parcel area must be at least 0.1 ha;
- for the crops or plantations to be established starting with the year of demand 2018, to prove that is using seed/ seedlings officially certified in accordance with Law no. 266/2002 regarding the production, processing, quality control and certification, marketing of seeds and seedlings, as well as testing and registration of plant varieties, published in the Official Gazette of Romania, Part I, no. 239/2014, with the exception of farmers participating in the small farmers scheme;
- to declare all agricultural parcels, except those having an area less than 0.1 ha and those aggregated do not exceed 1 ha, as well as ecological focus areas that contribute at applying beneficial practices for the climate and the environment;
- to declare, when submitting the single payment application, the updated identification data and contact and notify APIA about changing them within 15 calendar days of the change;
- legal entities must notify APIA within 15 days about changes occurred in the records of the National Trade Register Office regarding: administrator/ administrators, registered office, scope of activity;
- any changes of the date stated in the single payment application, as well within supporting documents that occurred in the period between the submission date of demand and the date of payment granting shall be communicated within 15 days in writing to the APIA;
- to comply with cross compliance rules established through national legislation based on art. 93 and Annex II to Regulation 1306/2013, on the entire agricultural area of the holding;
- to present, when submitting single payment request or changes occurred, the needed documents proving the legal use of agricultural land, including of lands containing ecological focus areas and animals. These documents must be completed before the application of the single payment request and must be valid at least until 1st December of the application year;
- to allow performing checks by APIA or by other institutions certified in this regard;
- to mark the used parcel limits, when is cultured with the same culture with neighboring parcels. In the case when the limits of commonly used parcels are not marked on the land,

farmers can be penalized proportionately for overstatement and/ or for failure of cross-compliance rules;

• to identify, declare and define precisely the agricultural parcels in the GIS "IPA-ONLINE" electronic application made available by APIA and to use the available cadastral data. Starting with he year 2018 identifying and delimiting of all agricultural parcels is obligatory based on cadastral data.

Single Payment applications shall be submitted by 15th May of each calendar year at APIA centers. Single payment applications may also be submitted after 15th May, within 25 calendar days, with a reduction of 1% for each working day of the amounts to which the farmer would have been entitled if the single payment application had been submitted until 15th May.

1. Single Area Payment Scheme consist of providing a single payment per eligible hectare declared by the farmer, payable annually and decoupled from production. To receive this payment, farmers must meet as well other conditions to those listed above, among which we mention:

- to apply for payment request with correct and complete data, together with all documents requested by the Agency for Payments and Intervention in Agriculture;
- to comply with cross-compliance rules;
- the farmers who in the year preceding the year of application for payment request, have received direct payments of over 5000 euros, to state at least the quality of self-employed person, individual or family businesses.

For this scheme Romania allocates minimum 47% of annual national ceiling EAGF.

2. The transitional national aids represent additional payments to be granted from the national budget to farmers from vegetal and livestock sectors that benefited from complementary national direct payments in the year 2013. The conditions of granting transitional national aids are identical to those authorized to grant payments related to the year 2013.

3. Redistributive payment is an annual payment intended for farmers who are entitled to the single area payment. Redistributive payment is additional to single payment, it is payable annually and it is decoupled from production. There can not benefit of redistributive payment farmers who created artificial conditions to receive support or those who have divided their holdings only after October 18th, 2011 only in the purpose to qualify for redistributive payment, or farmers whose holdings are the result of the concerned division. Redistributive payment shall be granted for the first 30 ha, irrespective of farm size and is allocated gradually on two levels - for the first 5 ha and for the remaining 25 ha.

For this payment Romania allocates about 5.3 - 5.7% of the national ceilings EAGF 2015-2020.

4. Payment for agricultural practices beneficial for the climate and environment (payment for greening) is a payment that is granted to farmers who are entitled to the single area payment and who are compulsory applying on all their eligible hectares the following agricultural practices beneficial for the climate and the environment :

a) diversification of crops;
b) the maintenance of existing permanent pastures;
c) the presence of an ecological focus area on the agricultural land.

The payment for agricultural practices beneficial for the climate and the environment, it shall apply to all farmers who are applying all practices that are set depending on the specific of holding and/ or crop structure. Farmers who practice organic farming system and hold a supporting document issued by an inspection and certification body approved by the Ministry of Agriculture and Rural Development benefit by default of the payment

for lands in conversion or certificates of the holding, used for organic production. Farmers who have the entire holding of permanent crops benefit of payment by default. In order to finance the payment for greening is using 30% of the annual national ceiling set out in Annex II to Regulation 1307/2013.

The amount of payment for greening per eligible hectare is calculated annually by dividing the related ceiling by the total number of eligible hectares. Crop diversification consists of the existence of different cultures on arable land, based on area as follows:
a) at least two different crops on areas between 10 to 30 hectares and the main crop to cover maximum 75% of the arable land;
b) at least three different crops on areas of over 30 hectares and the main crop to cover maximum 75% of arable land, respectively the two main cultures to cover together maximum 95% of the arable land;
c) by exception, where arable land area is covered in proportion of over 75% with grass or other herbaceous plants or fallow, the main crop on the remaining arable land area occupies maximum 75% of the remained arable land.
Farmers whose holdings are larger than 15 hectares shall ensure that, starting with the year 2015, minimum 5% of the arable land declared includes one or more of ecological focus areas as below:
a) terraces;
b) elements of landscape - hedgerows, woodland strips; isolated trees, trees in groups, clumps of bushes in the plains area or trees in alignment; field edges; ponds; gutters;
c) buffer zones located on the edges of flowing or standing water;
d) areas with forestry species of short production cycle;
e) wooded agricultural fields;
f) areas with topsoil;
g) areas with nitrogen-fixing crops;
5. Payment for young farmers includes giving an annual payment to farmers eligible for the single area payment.
Young farmers means those individuals who:
a) are established for the first time within an agricultural holding as leaders of the exploitation or who were already established in one of the five years preceding the first submission of an application under the single area payment scheme;
b) have a maximum age of 40 years in the mentioned application year;
c) submit the proof of graduation at least certain training courses of short duration.
The payment for young farmers shall be granted to each farmer for a period not exceeding five years. From that period is subtracted the number of years that have passed between the mentioned establishing and the first application for payment for young farmers.
The legal persons applying for the single area payment, irrespective of their organization form are receiving the payment under the scheme for young farmers if the following conditions are fulfilled:
a) are effectively and sustainable controlled in terms of management decisions, of benefits and financial risks by at least one young farmer in the first year when the legal entity applies for the single payment under the scheme for young farmers;
b) the young farmer complies with the related conditions.
The payment for young farmers is granted to legal persons only as long as at least one of the individuals who exercised the control over the legal person in the first year of its application for payment under the scheme maintains the control.
In order to finance the payment for young farmers, there are using maximum 2% of annual national ceiling set out in Annex II to Regulation 1307/2013.

The amount of the payment per hectare is 25% of the amount of the single payment area per hectare and it is granted for maximum 60 eligible hectares declared by the farmer.

6. Coupled Support Scheme is granted only in sectors or regions where particular types of farming or specific agricultural sectors which are particularly important for economic, social or environmental reasons undergo certain difficulties. The sectors and productions concerned are: protein crops, grain legumes, hemp, rice, grains, hops, sugar beet, fruit and vegetables, milk, mutton and goat meat, beef meat and silkworms.

For this scheme, Romania allocates 13.7% in the year 2015 and 14.9% in the year 2020, of the annual national ceiling EAGF.

7. Small Farmers Scheme involves providing an annual payment to farmers eligible for the single payment with the compliance of the following rules:

- The farmer receives an amount of direct payments equal to the total amount of payments to which the farmer is entitled each year (single area payment, ANT, redistributive payment, payment for greening and, where applicable, the payment for young farmers and coupled support) but no more than 1250 euros;
- During participation in the scheme, small farmers:

a) are exempted from using the agricultural practices beneficial for the climate and the environment;

b) does not apply administrative sanctions for non-compliance with cross-compliance rules;

c) keep at least a number of eligible hectares corresponding to the number of eligible hectares declared in 2015.

After at least one year, farmers may opt to move to the small farmers scheme of RDP, scheme that provides granting of 120% of direct payments level to which the farmer is entitled, if he undertakes to permanently transfer his entire holding to another farmer.

Considering all these payment schemes we simulated direct payments (*Table 3*) which can charge farmers depending on the area they hold and depending on the category to which each farmer is part of.

Table 3. Direct payments to farmers during the period 2015-2020 (EUR/ ha)

		2015		2016		2017		2018		2019-2020	
1-5 ha	SAPS	Max	74	Max	82	Max	84	Max	85	Max	85
	Greening	170	49	181	54	183	55	184	56	184	57
	Redistributive		5		5		5		5		5
	Young farmer	Min	23	Min	23	Min	23	Min	23	Min	23
	Vegetal TNA	128	19	141	17	144	16	146	15	148	13
5-30 ha	SAPS	Max	74	Max	82	Max	84	Max	85	Max	86
	Greening	210	49	221	54	223	55	224	56	224	57
	Redistributive		45		45		45		45		45
	Young farmer	Min	23	Min	23	Min	23	Min	23	Min	23
	Vegetal TNA	168	19	181	17	184	16	186	15	188	13
30-60 ha	SAPS	Max	74	Max	82	Max	84	Max	85	Max	86
	Greening	165	49	176	54	178	55	179	56	179	57
	Redistributive		0		0		0		0		0
	Young farmer	Min	23	Min	23	Min	23	Min	23	Min	23
	Vegetal TNA	123	19	136	17	139	16	141	15	143	13
>60 ha	SAPS	Max	74	Max	82	Max	84	Max	85	Max	86
	Greening	142	49	153	54	155	55	156	56	156	57
	Redistributive		0		0		0		0		0
	Young farmer	Min	0	Min	0	Min	0	Min	0	Min	0
	Vegetal TNA	123	19	136	17	139	16	141	15	143	13

Source: own calculations, taking into account the annual ceilings granted by the EAGF and allocations for each payment scheme

It appears that the biggest grant is possible to be charge by farmers holding between 5-30 ha, due to the fact that for this category of farmers redistributive payment is granted. So, a farmer who owns between 5-30 ha can benefit in the year 2015 of maximum 210 euros/ ha and the year 2020 maximum 224 euros/ ha. The smallest grants can be obtained by farmers who own more than 60 hectares (RAICOV ET AL., 2014; GOŞA ET AL., 2014).

CONCLUSIONS

It has become increasingly difficult to justify the substantial differences between the level of support per hectare granted to Member States resulting from the use of historical references, further distorting agricultural products market with public money. The right given to Romania and Bulgaria to contribute from national budgetary resources to complement national ceilings, merely confirms the existing inequalities between old EU member countries and new EU Member States. Romanian farmers will receive the lowest subsidies from the EU together with the farmers from Latvia and Croatia.

For the period 2015-2020 Romanian farmers have seven new payment schemes that they can access through the Agency for Payments and Intervention in Agriculture. Entering the multiple payment schemes causes complication, not simplification of the Common Agricultural Policy. This fact will lead at hindering the process of grants allowance to farmers.

The conditions for granting direct payments for the period 2015-2020 are making much harder due to: (i) the Agri-Environmental conditions that must complied by farmers (crop diversification, maintenance of existing permanent pastures and the presence of an ecological focus area on agricultural land); (ii) unequivocally identification of agricultural parcels that allows a tolerance of only 0.75 meters to their identification within IPA online system.

Farmers who in the previous year of payment received grants exceeding EUR 5,000 must become active farmers. Those who received grants of less than 5000 euros are automatically considered active farmers.

The amounts received by each farmer will be influenced by the size class of the farm, by the farmer's age and the application of certain agri-environmental conditions.

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ROLE OF *FUSARIUM* SPECIES IN MYCOTOXIN CONTAMINATION OF MAIZE

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ABSTRACT
Mycotoxin contamination of maize and other cereals is a globally important risk for human and animal health. The most frequently detected mycotoxins in maize are trichothecenes, zearalenone and fumonisins, which are causative agents for various diseases in domestic animals and they are a threat to humans either directly or indirectly.
The main producers of these mycotoxins, *Fusarium* species are considered the most important pathogens in the temperate climate zone of maize. Between 2011 and 2014 numerous incidence of *Fusarium* species and mycotoxins were assessed from Hungarian maize samples after harvest. Samples were collected from 8-10 maize growing areas of Hungary from hybrids with various resistant levels. The isolated *Fusarium* strains were identified using morphologic and sequence-based methods. In 2011 and 2012 14.3% and 9.2% of maize samples were found to be contaminated with potentially toxigenic isolates. The ratios of *Fusarium* isolates were 60.3% and 68.1%, respectively. In 2013 and in the highly humid 2014, 50.1% and 71.4% of maize grains were contaminated, while 46% and 84.9% of the isolated fungal strains belonged to genus *Fusarium*. *F. verticillioides* isolates were identified in the largest proportion of the samples, which are potential fumonisin producers. Along with these species *F. graminearum, F. proliferatum, F. subglutinans* and *F. sporotrichioides* isolates were also observed, which can produce trichothecens, beauvericin, moniliformin and toxin T-2. Representatives of *Fusarium culmorum* were not detected in any of the years examined.

Keywords: *Fusarium,* maize, species distribution, mycotoxin, fumonisin

INTRODUCTION

Maize (*Zea mays* L.) is the most important ingredient of feeds, and one of the most important agricultural export product of Hungary. Food and feed safety problems have increasing significance in maize production. Several fungal pathogens are able to infect maize, many of them are able to cause mycotoxin contamination. The most important mycotoxin producers are members of the *Fusarium* and *Aspergillus* species. Although *Fusarium* toxins, including trichothecenes, zearalenone and fumonisins, are considered to be the most important in cereals in regions with temperate climate (*Table 1*; LOGRIECO ET AL., 2002), mycotoxins produced by Aspergilli are also frequently identified in cereal products (HALT ET AL., 2004; GIORNI ET AL., 2007; TABUC ET AL., 2009).
In Hungary, the main toxin producer species are *F. verticillioides* and *F. graminearum*, but many toxin producing species of smaller significance can also be found (VARGA ET AL., 2004).

Table 1. Nomenclature of *Fusarium* species and their mycotoxins

Fusarium species	Mycotoxins
Fusarium acuminatum	T2, MON, HT2, DAS, MAS, NEO, BEA
Fusarium avenaceum	MON, BEA
Fusarium cerealis	NIV, FUS, ZEN, ZOH
Fusarium chlamydosporum	MON, BEA
Fusarium culmorum	DON, ZEN, NIV, FUS, ZOH, AcDON
Fusarium equiseti	ZEN, ZOH, MAS, DAS, NIV, DAcNIV, FUS, FUC, BEA
Fusarium graminearum	DON, ZEN, NIV, FUS, AcDON, DAcDON, DAcNIV
Fusarium oxysporum	MON, BEA
Fusarium poae	DAS, NIV, FUS, MAS, T2, HT2, NEO, BEA
Fusarium proliferatum	FB1, BEA, MON, FUP, FB2
Fusarium sambucinum	DAS, T2, NEO, ZEN, MAS, BEA
Fusarium semitectum	ZEN, BEA
Fusarium sporotrichioides	T2, HT2, NEO, MAS, DAS
Fusarium subglutinans	BEA, MON, FUP
Fusarium tricinctum	MON, BEA
Fusarium verticillioides	FB1, FB2, FB3

AcDON, monoacetyldeoxynivalenols; AcNIV, monoacetylnivalenol; BEA, beauvericin; DAcDON, diacetyldeoxynivalenol; DAcNIV, diacetylnivalenol; DAS, diacetoxyscirpenol; DON, deoxynivalenol; FB1, fumonisin B1; FB2, fumonisin B2; FB3, fumonisin B3; FUP, fusaproliferin; FUS, fusarenone-X; FUC, fusachromanone; HT2, HT-2 toxin; MAS, monoacetoxyscirpenol; MON, moniliformin; NEO, neosolaniol; NIV, nivalenol; T2, T-2 toxin; ZEN, zearalenon; ZOH, zearalenols

Fusarium verticillioides (Sacc.) Nirenberg, (teleomorph = *G. fujikuroi* (Sawada) Ito in Ito & K. Kimura) is a widely distributed pathogen of maize which is able to cause maize seedling blight, root rot, stalk rot and ear rot, and also can infect maize as an endophyte, without any symptom development. Both symptomatic and asymptomatic kernel infections by *F. verticillioides* can result decreased quality and economic losses due to contamination by fumonisins. These polyketide derived mycotoxins causing various diseases in animals including kidney and liver cancer in rodents, pulmonary edema in pigs, leukoencephalomalacia in horses and may have postulated role in human esophageal cancer. Many of the current maize hybrids are susceptible to ear rots, therefore those are exposed to fungal and toxin contamination under epidemic conditions. *Fusarium graminearum Schwabe (teleomorph = Gibberella zeae (Schwein.) Petch) is also an important pathogen of cereal crops causing primarily head blight in wheat and stalk and ear rot of maize. They produce mainly deoxynivalenol and zearalenone toxins.*

Several researchers have recently investigated the effects of climate change on mycotoxin contamination (DOBOLYI ET AL., 2011). For *Fusarium* infections the moderately warm, humid weather is optimal. The average summer temperature with higher humidity favors the spread of *F. graminearum*, but at a higher temperature *F. verticillioides* expansion can take place. Contrary, *Aspergillus flavus* requires especially dry and hot conditions to develop significant toxin contamination. Therefore, in maize some of the toxin contamination is a risk nearly every year. Maize products are frequently contaminated by fumonisins which are principally produced by *Fusarium* species, although black Aspergilli also occur frequently on maize kernels. In this study, we investigated the occurrence of these species and their mycotoxins on maize in various maize growing areas in Hungary in four consecutive years after harvest.

MATERIAL AND METHOD

The samples were collected in various maize growing regions in 2011-2014. The samples were surface sterilized using ethanol (*v/v%: 70%*), and plated onto dichloran rose Bengal agar (DRBA) media (KING ET AL., 1979). Plates were incubated at 25 °C and after two weeks outgrowing mycelia were purified and transferred to malt extract agar (MEA) and potato dextrose agar (PDA) media. Isolates were subcultured as single conidia on MEA, Czapek-yeast extract agar (CYA) and potato dextrose agar (PDA) plates. Morphological identification of Aspergilli/Penicillia isolated from maize grains have been done according to standard textbooks and monographs (RAPER AND FENNELL, 1965, SAMSON ET AL., 2004, 2010). For sequence based identification, the cultures used for the molecular studies were grown on malt peptone (MP) broth for 7 days, and DNA was extracted from the mycelia using Masterpure™ yeast DNA purification kit (Epicentre Biotechnol.) according to the instructions of the manufacturer. Species level identification of the selected isolates was performed by sequence analysis using genomic regions (*Fusarium* species: translation elongation factor gene; *Aspergillus* species: calmodulin gene; in section of other species: ITS region, PILDAIN ET AL., 2008). Sequences were compared using nucleotide-nucleotide BLAST (blastn) with default settings (http://blast.ncbi.nlm.nih.gov; ALTSCHUL ET AL., 1990) to the Genbank database, and to our own sequence database.

RESULTS AND DISCUSSION

In 2011 and 2012, the weather conditions were hot and dry. In 2012, extreme weather conditions were observed in Central Europe, when July and August were almost 3 °C warmer than the 100 years' average, and the amount of precipitation in August was only 13% of the average. In 2011, the average infection rate of maize grains was 14.3%. The proportion of *Fusarium* species were nearly 60.3% (*Figure 1*) and most isolates belonged to species *F. verticillioides* (70%), but *F. graminearum* (4%), *F. proliferatum* (24%), *F. subglutinans* (1%) and *F. oxysporum* (1%) have also occurred in the samples. The ratio of presence of Aspergilli was 8%. Besides the potential aflatoxin producer *A. flavus,* representatives of *A. niger* were also identified which can produce fumonisins and ochratoxins.

Due to the hot and dry climate of 2012, fungal infection of grains was reduced to 9.2%, while 68.1% of the isolated fungus belonged to genus *Fusarium* and 16% belonged to genus *Aspergillus*. Most isolates belonged to species *F. verticillioides* (74%), but *F. graminearum* (3%) and *F. proliferatum* (23%) also occurred in the samples. Within genus Aspergilli *A. flavus* isolates dominated, and we isolated some *A. clavatus* in smaller proportion which can produce patulin. In that year, the southern parts of the country had serious aflatoxin contamination in maize.

2013 was characterized by a dichotomy, in regards of volume of precipitation and temperature. The average fungal contamination was lower than in previous years (50.1%). The rate of *Fusarium* species was 46% - 69% of the isolates belonged to *F. verticillioides*, 28% to *F. proliferatum*, 3% to *F. subglutinans* and no isolate of *F. graminearum* was found. 9.6% of the isolated fungi belonged to genus *Aspergillus*. Most of these were the potential aflatoxin producer *A. flavus*, and a smaller proportion was *A. niger* and *A. ochraceus*.

An infection rate of 71.4% of maize samples was observed due to the extremely high precipitation in 2014. The rate of *Fusarium* isolates was 84.9%. 44% of the isolates belonged to *F. verticillioides*, 29% to *F. graminearum*, 23% to *F. proliferatum*, 3% to *F.*

subglutinans and 1% belonged to the species *F. sporotrichioides*. We couldn't isolate any *A. flavus* from the maize samples in 2014. *Aspergillus* contamination was not detected among the maize samples.

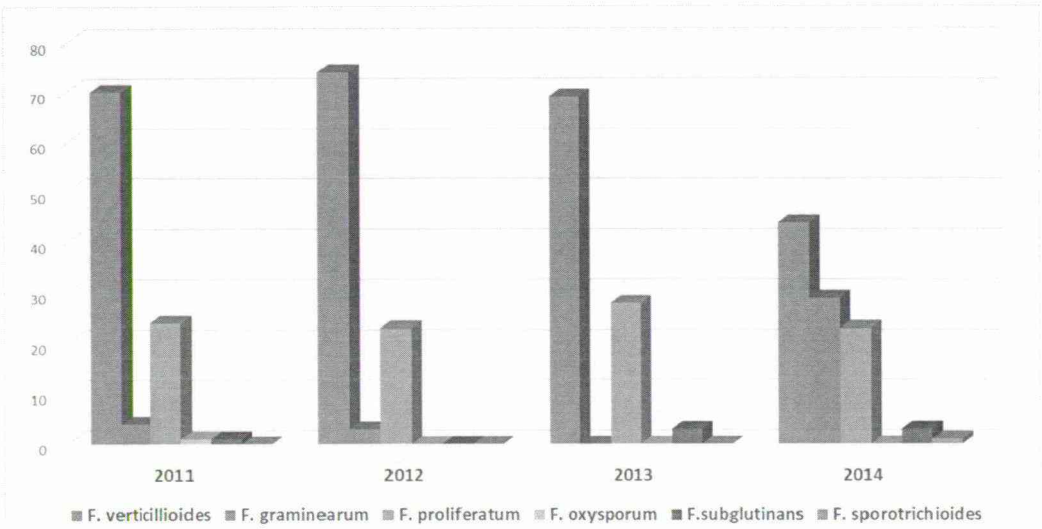

Figure 1. Incidence of mycotoxinogenic fungi in Hungarian maize samples between 2011-2014

In 2011, we identified several endophytic *Sarocladium zeae* (synonym: *Acremonium zeae*) isolates as well. This species is an antagonist of mycotoxinogenic *A. flavus* and *F. verticillioides*. This was the first data of occurrence in Hungary. In antimicrobial activity tests, *S. zeae* extracts containing pyrrocidin showed inhibition on these two pathogenic fungi.

Results of this survey verified, that according to the change of growing conditions the pathogen species distribution can change. Presence of *F. verticillioides* dominates when the temperature conditions are not favorable for *F. graminearum*. Representatives of *Fusarium culmorum* were not detected in any of the years examined. The possible reason is that warmer weather conditions strongly limit the spread of the pathogens.

Our results indicated that black Aspergilli had little role in the fumonisin contamination of maize, however the *Aspergillus flavus* infection represents a potential risk for aflatoxin contamination of Hungarian agricultural products.

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CO-FERMENTATION EXPERIMENTS WITH AGRICULTURAL MAIN PRODUCTS AND LIQUID PIG MANURE

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ABSTRACT
My research work proposes the study of the impact of the biogas production by the co-fermentation of agricultural products. The basic substance is the dangerous liquid pig manure of the concentrated stock of big pig farms. The energetic utilization of these materials means bigger income for the agricultural enterprises, savings in the replacement of the plant nutrition with the utilization of the bio-manure, increase in the performance of the plant production, making the dung harmless which means a big environmental load. Because of the profitability of bioenergy utilization depends on the local conditions, it is necessary to do experiments to try the available composition of organic wastes in the ratio of the production in advance. I measured the quantity of the methane and CO_2 content of the biogas released from the substrate. The experiment simulated real biogas plant conditions, in mesophilic temperature, continuous biodegradation process. It can be considered, as a semi-industrial size.

Keywords: sustainable agriculture, environmental protection, increasing the profitability of the agricultural production

INTRODUCTION

Based on our research and literature references, it can be proven that the qualitative and the quantitative properties of the biogas released in the biogas plants largely depends on the portioned liquid dung, the additives and the features of the applied technology. Our experiments justified the yield improving effect of the agricultural main and by-products as well as wastes because of the low organic matter content of the liquid pig manure. It may be hypothesized, that these additives and the technological parameters of the biogas production influence the features of the fermented manure and through this the opportunities of the recirculation in a favorable direction.
Our experiments aimed the increasing of the proportion of the renewable energy sources of application, to increase the methane quantity originating from the various organic matters, to increase the intensity of the formation, to produce stabile gas content. Making the organic matters polluting the environment harmless is the indirect result of the application of the technology (GOTTSCHALK, 1979). The biogas increasing the greenhouse effect with big methane content means concentrated environmental load and source of danger, and on the other hand, an unutilized energy source on a farm where the use of the exterior power sources is considerable anyway. While the economic size is its principle from below, the relatively little energy content of the biomass in the view of the transportation expense from above limits the firm concentration (GERARDI, 2003). Because of this, it is expedient to examine the energetic utilization of all possible organic waste at least with laboratory or half firm methods.

MATERIAL AND METHOD

At the Engineering and Agricultural Faculty of the Szolnok College, there is an appropriate, available, semi-automatic experimental system, representing the operating circumstances, providing similar conditions suitable for the formation process of the biogas, regulating the change of influencing factors and all the necessary measurements of typical data. The liquid pig manure was used during our biogas production experiments as basic substance. The application of an appropriate bacterium strain may decrease the time of fermentation and the measure of the demolition may improve and the methane content of the forming biogas may be growing.

The supreme features of the industrial by-products and wastes suitable for biogas production are

- the dry matter-,
- organic matter,
- nitrogen content,
- C:N proportion,
- specific gas yield.

The technology of fermentation experiments, the process of the experiment series:

a) Loading of laboratory digesters, setting of the treatment combinations
b) Sampling.
c) Measurements, examined parameters

The technology of fermentation experiments

We divided the process of the fermentation into sections according to the *Table 1.*

Table 1. The technology of the co-fermentation experiments

No.	Process period	Duration	Treatments, fermenters				Comment
			1.	2.	3.	4.	
1.	stabilization	7 days	Composition: 50% fresh liquid manure; 25% manure from the store; 25% sludge from the store				same circumstances
2.	refilling period with fresh substance	14 days	7 v/v% refilling with fresh substance daily				
3.	refilling with fresh substance daily (running up period)	15 days	4.4 v/v% refilling with fresh substance daily				32 – 37 °C different processes
			control	C_{35} 30 g d.m./day	C_{36} 30 g d.m./day	Hemp 30 g d.m./day	
4.	refilling with fresh substance daily (comparative experiments)	15 days	4.4 v/v% refilling with fresh substance daily				
			control	C_{35} 30 g d.m./day	C_{36} 30g d.m./day	Hemp 30g d.m./day	

We can dose ~50 dm^3 of liquid dung mixture pro treatment to take the factors in connection with the capacity of the fermenters into account. It is possible to examine simultaneously the effect of 9 treatment combinations with hermetically closed fermenters mobile by manual power placed in a heatable room. We applied the continuous (filling up) system, which is most widespread in the practice. The process sections, as the launching, load change, receipt change can be reproduced according to certain experts' opinions, and

each single daily measurement combinations for a separate experiment can be qualified (KALMÁR ET AL., 2003).

Table 2. The parameters measured during the experiment series

Serial No.	Measured parameter	Device	Method	Comment
1.	fermenter temperature (°C)	digital thermometer		once a day, at the same time
2.	gas yield (dm^3)	gas meter		
3.	gas content (%)	GA45 gas analyser		
4.	conductivity (mS/cm)	Hydrolab	electrometric	once a day, at the same time
5.	soluted oxygen (mg/l)			
6.	pH			
7.	salination (PSS)			
8.	redoxpotential (mV)			
9.	BOD5 (mg/l)	Oxi Top 110	pressure dropping	from samples selected based on professional viewpoints
10.	COD (mg/l)	NANOCOLOR	photometry	
11.	dry matter content	drying cupboard		once a day, at the same time

We measured the most important parameters to follow the degradation process (*Table 2*). *Table 1.* contains the different treatments in the different process periods.

The statistical methods used for the evaluation of co-fermentation experiments

We used Excel spreadsheet and SPSS for Windows 18.0 for the statistical analysis. The data were analyzed by variance with independent two-T sample. We examined the homogeneity with Levene test. For the group pair comparison Tamhane test was used in the case of heterogeneity, and LSD test in the case of homogeneity. The relationship between variables was determined with correlation analysis tests (Pearson's correlation coefficient) and linear regression analysis.

RESULTS

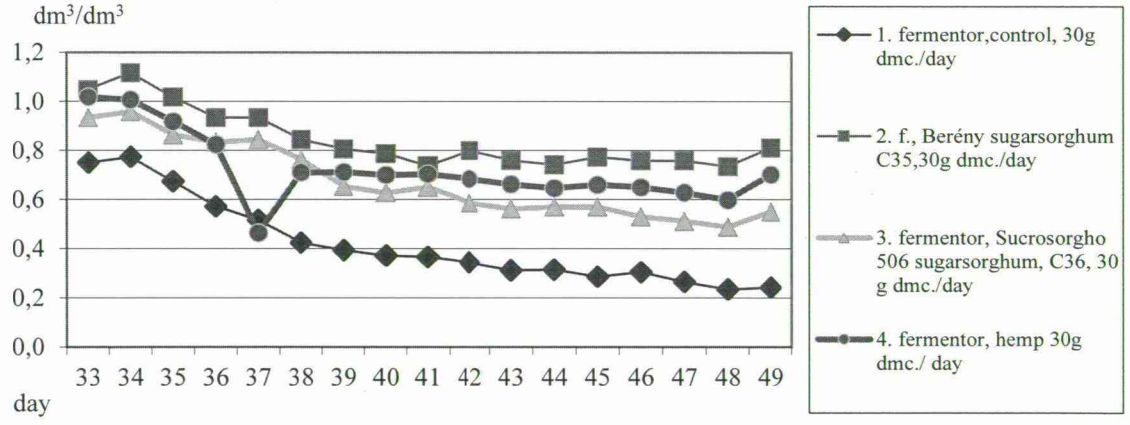
The average biogas yield of the control fermenter was 21 Nm^3/day, the methane production at 55-57% methane content was 12.7 Ndm^3/day. The specific methane production related to 1 kg dry matter was 78 Ndm^3 (*Table 3*). The C_{35} sugar sorghum doped (fermenter No. 2) produced 42.2 Ndm^3 biogas per day, the average biogas yield of the fermenter No.3 was 33 Ndm^3/day. The reason of the difference is the maturation status of the different species and the different sugar content.

Table 3. The gas production of the fermenters during the comparative experiments with sugar sorghum (C_{35},C_{36}) and hemp whole plant additives

Fermenters, treatment	Average production			Specific gas production			
	biogas	methane		biogas	methane	biogas	methane
	Ndm^3/day		%	Ndm^3/kg d.m.		dm^3/dm^3 fermenter-volume/day	
Fermenter No. 1 (control)	21.0	12.7	60.5	129.6	78.4	0.42	0.25
Fermenter No. 2: Berény sugar sorghum, C_{35}, 30 g d.m./day	42.2	22.6	53.6	22.7	118.6	0.84	0.45
Fermenter No. 3: Sucrosorgho 506 sugar sorghum, C_{36}, 30 g d.m./ day	33.8	20.0	59.2	162.4	96.1	0.68	0.40
Fermenter No. 4: hemp, 30 g d.m./ day	36.1	19.8	54.8	183.9	100.9	0.72	0.40

The C_{35} sugar sorghum with higher sugar content produced more biogas at the time of the experiments. However, the methane content of this was lower thus the yield is only 2.6 dm^3/day more than the methane production of the other fermenter with lower sugar content.

Figure 1. Specific biogas yield of the fermenters during the comparative period of the experiment compared to the fermenter volume



The stability of the biogas production is depending on the decomposition of the organic matter, on the quality of the technology and on the amount of organic matter overloaded (*Figure 1*). Experiments of the most stable yield intensity could be performed with the fermenter No. 2. In the case of other fermenters, the production decreased in a few ways only (*Figure 2*). The decreasing production was sometimes in connection with a little increasing dry matter content (*Figure 3*).

In our experiments, the figures of the biogas production and the methane content of the released biogas proved the relation between the biogas production intensity and the methane content. To determine the level of the correlation is the next aim of our research.

Figure 2. Methane content of the biogas during the comparative experiments

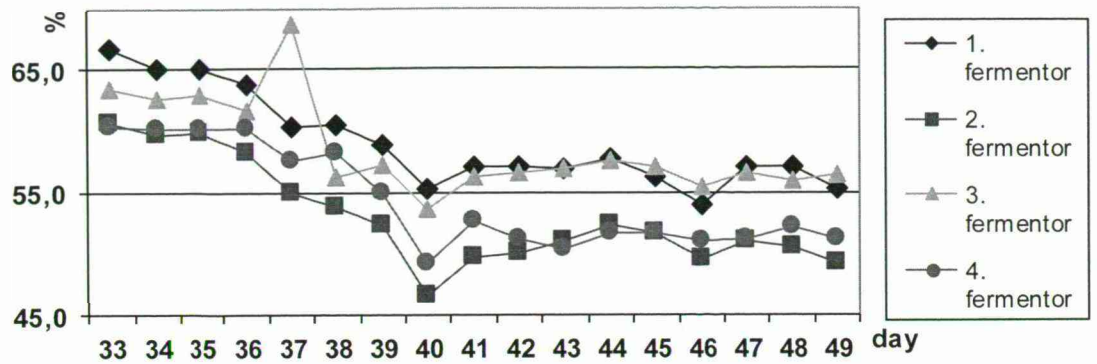
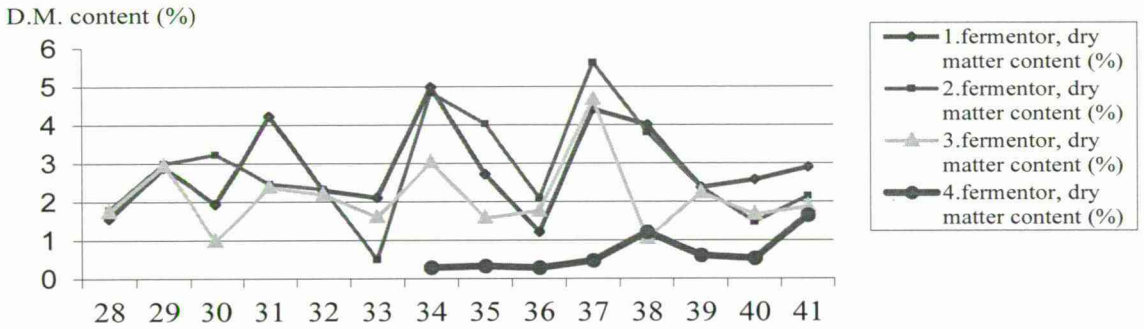


Figure 3. Dry matter content during the examination period



CONCLUSIONS

The biogas production technology based on the pork liquid dung and on the other wastes of the processing of agricultural main products known, and the accepted technological procedures in the EU's member states, results in the production biogas and fermented manure. The quantity and the quality of the raw materials and additives, the parameters of the applied technology as well as the biogas production are strongly depending from each other.

At the end of the comparative experiments, we can determine, that the utilization of the whole plant additives increases the biogas production of the liquid pig slurry, and this increase is significantly bigger than the decrease of the methane content. The justification of the relation between the maturation degree and the value of the sugar content of the different species needs further investigations.

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THE CO-ADSORPTION OF METHANE AND CARBON DIOXIDE ON CATALYSTS

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ABSTRACT
In the elucidation of the reaction mechanism of a catalytic process it is important to establish the reaction intermediates and their possible role in the reaction. In most cases, however, this is not an easy task as a real reaction intermediate exists only transitorily and in a very low concentration on the catalysts.
The adsorption of CO_2 and the co-adsorption of CH_4 + CO_2 on Re supported by Al_2O_3, TiO_2, SiO_2 and MgO have been investigated by FTIR spectroscopy. The dissociation of CO_2 was not experienced on the Re/Al_2O_3 reduced at 673 K, it occurred, however, on the sample reduced at 1073 K.
Addition of CH_4 to CO_2, initiated the dissociation on all catalysts as indicated by CO bands at 2041 cm^{-1}. Besides, new spectral features were developed at 1599 and 1397 cm^{-1} attributed to format species.
No bands due to format were detected on Re/SiO_2 and no format was detected following the co-adsorption of CO_2-containing gas mixture on the supporting oxides alone. It was assumed that the format species identified in the surface interactions is located on the support, where it is stabilized. The possible pathways of the occurrence of format complex on the oxides are described.

Keywords: co-adsorption, catalyst, support, $CH_4 + CO_2$ reaction, formate

INTRODUCTION

The number of organic chemical products produced in the world moves about 30000 nowdays (WEISSERMEL AND ARPE, 2010). But despite the relatively large numbers, they are just made from a few raw materials. The applied coal is obtained almost exclusively from fossil sources – namely mineral oil, natural gas and hard coal.
The limited resources of coal raised the problem of the exploitation of alternative carbon sources in the early 1970s.
Carbon dioxide has always enjoyed great attention because of the nature of synthetic building process used successfully during photosynthesis - which can be considered as the basis of life on Earth as well.
In our planet the amount of CO_2 and CO_3^{2-} forms are available several times higher than natural resources in the form of hard coal, oil or natural gas form. In addition, this source is virtually limitless, especially if we consider that since the middle of the 19th century at the beginning of industrialization – the amount of "anthropogenic" CO_2 has multiplied considerably in the atmosphere. In 1989 the amount of CO_2 emission due to industrial activities was approximately 7×10^9 t (LEITNER, 1995).
Supported Re is a widely used catalyst in several technologically important reactions, such as the reforming of petroleum feedstock (CIAPETTA AND WALLANCE, 1971).
Re also exhibits oxygen storage properties in automatic three-way catalysts (TAYLOR ET AL., 1984).

MATERIAL AND METHOD

Supported rhenium was prepared by impregnating the support in aqueous solution of $(NH_4)_2ReO_4 \cdot 4H_2O$ (Merck).The following supports were used: SiO_2 (CAB-O-SiL, and MS Scintran BHD); Al_2O_3 (Degussa); TiO_2 (Degussa P25) and MgO (DAB).

After impregnation, the suspensions were dried in air at 383 K. The dried and pulverized samples were pressed into thin self-supporting wafers (30 mm x 10 mm, ~60 mg/cm^2). Further treatment was applied in situ: it consisted of oxidation at 573 K (100 Torr of O_2 for 30 min), evacuation at 573 K for 30 min, reduction at 673 K and at 973-1073 K (100 Torr of H_2 for 60 min), and evacuation at the temperature of reduction for 30 min.

Note that the heating of the sample from 573 K to the temperature of reduction was carried out in the presence of hydrogen. As hydrogen can promote the dissociation of CO_2, it was absolutely necessary to remove completely the hydrogen from the system after the reduction of Re catalyst, otherwise the appearance of CO bands cannot be avoided. The Re content was 5 wt% on all samples.

Infrared spectra were recorded with a Digilab. Div. FTS 155 by Biorad with a wave number accuracy of ±4 cm^{-1}. Typically 128 scans were collected. All of the spectra were taken without the use of a scaling factor (f = 1.0).

RESULTS

CO_2 adsorption

The spectra obtained after adsorption of CO_2 on Re/Al_2O_3 (T_R = 673 K) are displayed in *Figure 1A.*

Strong bands appeared at 2334, 1646, 1481, 1443 and 1232 cm^{-1}. The intensity of which only slightly decreased after degassing at 300 K.

There were no other spectral features following the adsorption at higher temperatures, 373-673 K. Similar experiment on the Re/Al_2O_3 reduced at 1073 K produced a weak absorption band at 2040 cm^{-1}, in addition to the previously observed peaks (*Figure 1B*).

For Re/MgO, we measured absorption at ~2334, 1660-1670, 1450, 1543, 1310 and 1220 cm^{-1} at 300 K (results not shown).

Admission of CO_2 on Re/TiO_2 at 300 K produced bands at 2334, 1667, 1582, 1438, 1378 and 1322 cm^{-1}. The position of which was independent of the temperature in the range of 300-573 K. In the case of Re/SiO_2, we obtained only a band at 2334 cm^{-1}. Evacuation of the cell led to the elimination of the 2334 cm^{-1} feature in all cases, but did not affect the other bands (results not shown).

The most sensitive method to detect the dissociation of CO_2 on supported metals is the FTIR spectroscopy. The spectra presented in *Figure 1* clearly show that the dissociation of CO_2 is very limited on Re/Al_2O_3. Admission of CO_2 on Re/Al_2O_3 (T_R = 673 K) at 300 K produced a strong band at 2234 cm^{-1} due to CO_2 and several others at 1646, 1481, 1443 and 1233 cm^{-1} due to carbonate species. Other spectral feature in the CO stretching region was not seen even after adsorption at 573 K. Evacuation of the cell led to the disappearance of the CO_2 band at 2334 cm^{-1} and did not affect the other bands due to the vibration of carbonates. A CO band at 2040 cm^{-1} suggesting the dissociation of CO_2, however, appeared on highly reduced Re/Al_2O_3 (T_R = 1073 K).

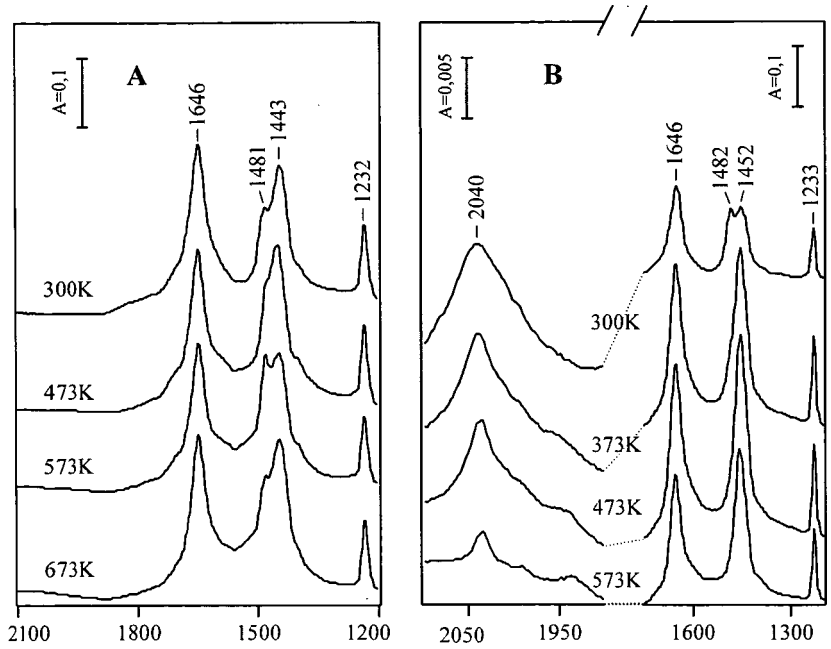

Figure 1. FTIR spectra of Re/Al_2O_3 following the adsorption of CO_2 (50 Torr) at different temperatures for 15 min (T_R = 673 K) Reduction temperature: 673 K (A) and 1073 K (B)

CH_4 + CO_2 adsorption

Adding methane along with CO_2 caused the appearance of CO band at 2041 cm^{-1} on Re/Al_2O_3 even at room temperature (*Figure 2A*).

The position of the bands in the low frequency region remained unaltered. Raising of the adsorption temperature led to the attenuation of all bands. Weak spectral features were detected at 1599 and 1397 cm^{-1} following the adsorption at 473 K. These weak spectral features were also detected at 573 K (not shown). More intense absorption bands were experienced on Re/TiO_2 sample (*Figure 2A*).

In addition to the band at 2043 cm^{-1}, weaker peaks appeared at 2009 and 1963 cm^{-1}. On this catalyst a widening of the band at 1583 cm^{-1} also occurred at higher temperature and a peak at 1557 cm^{-1} can be distinguished (*Figure 2A*). Co-adsorption of CH_4 + CO_2 mixture on Re/MgO at 373 – 473 K resulted in a formation of a shoulder at ~ 1580 cm^{-1} (*Figure 2B*). On Re/SiO_2 we obtained only very weak absorption at 1877 cm^{-1}.

Interestingly, the dissociation of CO_2 was also facilitated by methane even at 300 K (*Figure 2).* The intensity of CO band was, however, much lower. This is not surprising, if we assume that adsorbed hydrogen is needed for dissociation of CO_2. As both CH_4 and CO_2 adsorb weakly over Re at 300 K, we can exclude the direct surface interaction between the two adsorbed species.

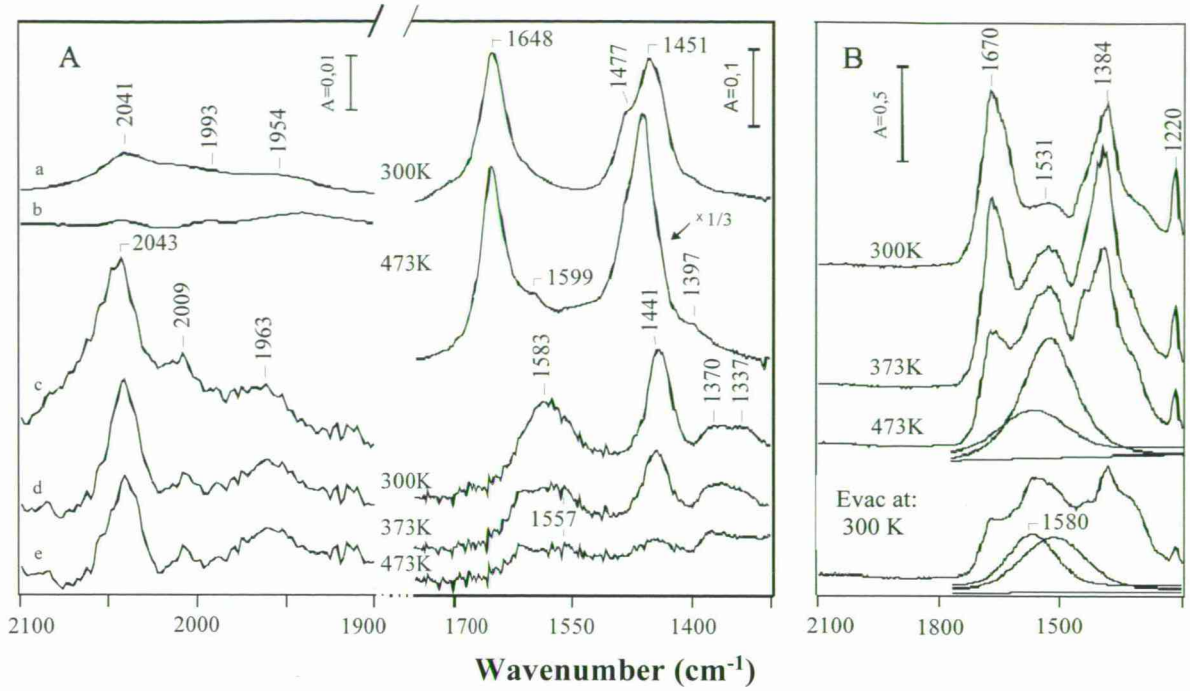

Figure 2. FTIR spectra of Re catalysts following the adsorption of CH_4 + CO_2 (1:1) gas mixture at different temperatures for 15 min (T_R = 673K) Supports: (A) Re/Al_2O_3 (a, b); Re/TiO_2 (c-f); (B) Re/MgO

CONCLUSIONS

The adsorption of CO_2 on Re supported by Al_2O_3, TiO_2, MgO and SiO_2 have been investigated by FTIR spectroscopy. The dissociation of CO_2 was not experienced on the Re/Al_2O_3 reduced at 673 K, it occurred, however, on the sample reduced at 1073 K.
No format was detected following the co-adsorption of CO_2-containing gas mixture on the supporting oxides alone. It was assumed that the format species identified in the surface interactions is located on the support, where it is stabilized.
Addition of CH_4 to CO_2, initiated the dissociation on all catalysts as indicated by CO bands at 2041cm^{-1}. Besides, new spectral features were developed at 1599 and 1397 cm^{-1} attributed to format species. This assumption was confirmed by the adsorption of HCOOH vapor on these solids.

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YOUNG FARMERS' INCOME GENERATING CAPACITY AND CAPITAL REQUIREMENT: CORN PRODUCTION

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ABSTRACT
The study examines the farms growing on arable crops run by young farmers from economic point of view. The income generating capacity and capital needs of the sectors based on corn cultivation are assessed, while the announced tender scoring system is taken into account. The number of agricultural and horticultural sectors with specialized young plant production farms increased strongly in recent years, so the results of these agricultural businesses have always been and still are in close connection with their production structure. The amount of income on these farms basically depends on the structure of production influenced by the income generating capacity, the capital requirements, the amount of the subsidies and the use of the relations opportunities of the industry. The versatility of the use of corn produces different income generating capability and capital requirements which young farmers can successfully take advantage of during the design and operation period of their enterprises.

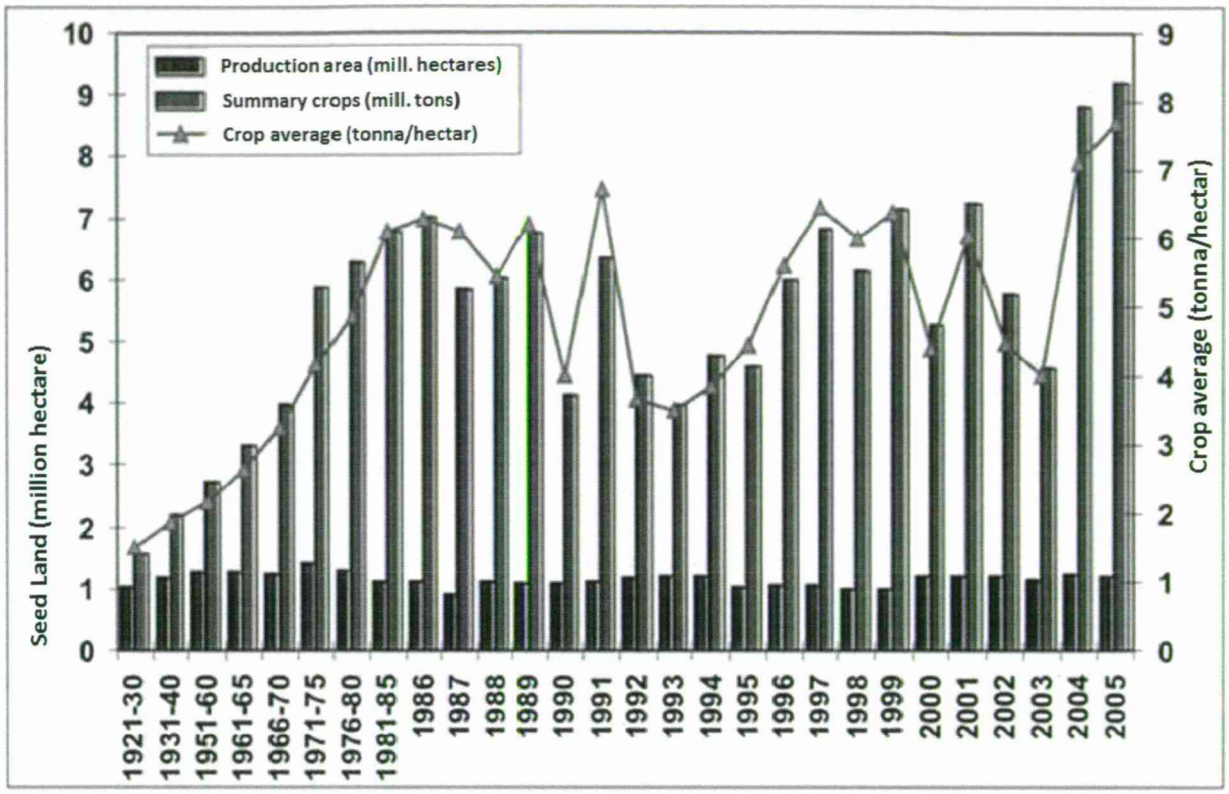
Keywords: young farmer, corn, income, capital requirement, EUME

INTRODUCTION

In Hungary, the corn has been a crop grown on the largest cultivated area, its area is stable in the average of the past few years it was 1.1-1.2 million ha (*Figure 1*), however, the national average yield varies greatly. Corn is one of the most important crops, food, animal feed and industrial plants in the world and also in Hungary (MÁRTON, 2015). It occupies 16% of the world's arable land, (161 million ha), and 27% of the arable land in Hungary. The total yield of corn production is 820 million tons in the world, and 5-8 million tons in Hungary. Now the corn is grown almost everywhere throughout the world, due to its adaptive properties and the purposeful activity of breeders. The use of corn - both the main and the by-products - is extremely versatile and varied. All over the world and in Hungary as well, mainly it has a part as an energy-rich animal feed, however in the developing countries struggling with problems about 80-90% of the corn yield is utilized as human food. Corn in animal feed has a significant role in energy supply (FERENCSIK, 2015). It starch content is about 65-70% starch value 700-800 g/kg, the energy value 8.5-9.5 MJ/kg of dry matter.

The use of corn

In order to analyse the income-generating capacity of the of young farmers' arable crop production we need to clarify the areas where corn is used (*Figure 2*).



Source: http://www.pointernet.pds.hu

Figure 1. Corn area, average yield and total yield in Hungary between 1921 and 2005

Human nutrition:

- Sweetcorn
- Pop-corn
- Cornmeal, corn flour

Animal feed:

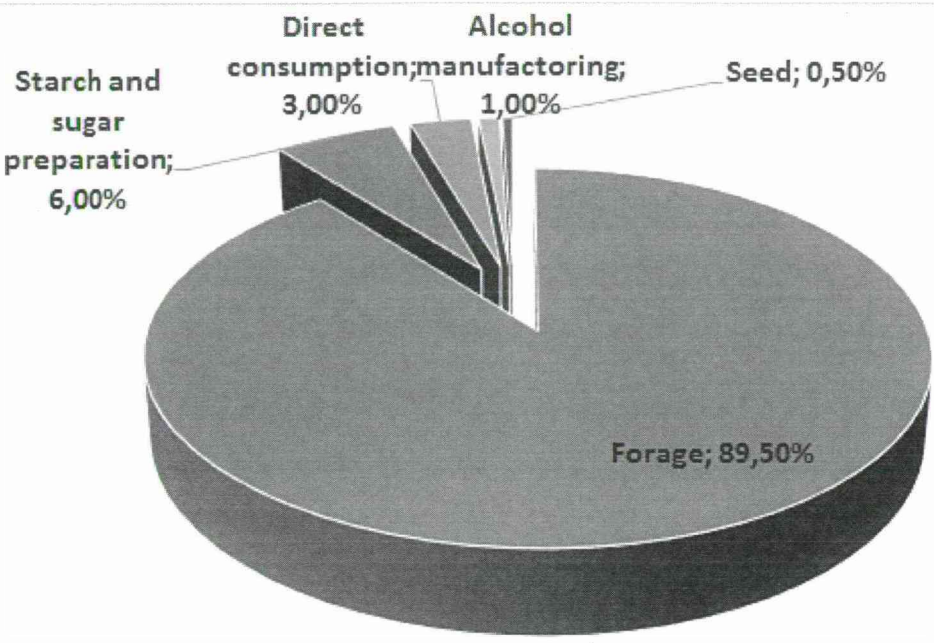
- Mass feed (silage)
- Maize grain

Industrial use:

- Bio ethanol ("High Total Fermentable" hybrids with high starch content)
- Starch
- Corn oil
- Invert sugar

Stem

- Heating
- Incorporated into the soil as a nutrient (ANTAL ET AL, 2005)



Source: Győri, 2001

Figure 2. Corn Utilization in Hungary

MATERIAL AND METHOD

Our investigations were carried out in Hungarian corn growing areas of the South Great Plain Region (Csongrád, Bács-Kiskun and Békés Counties) only. Qualitative research method was used with interviews in which our questions were grouped in themes and topics previously defined. The questions were asked directly from young farmers, who operated the farm, then we recorded and analysed the replies. The interviewees were mainly the leaders of already existing farms, run by young farmers, who have been operating for 1 to 5 years. The cost and income conditions were projected to one (1) hectare, without any fees and contributions, expressed as a net amount. Among the costs the land rental fees were not considered, as they are approximately the same as the value as the support provided with regard to the size of the area for producing a certain type of cultivated plant (TERA). The results thus obtained only apply to small farms (5-20 ha), since the size of the farms operated by young farmers were all within this value. There is no doubt that large farms can be managed more profitably, they have better bargain position in the purchase of inputs, and also significant savings show in fertilizer and diesel fuel use, and their profitability is reflected in less expenditures for transportation, drying and harvesting as well.

Specific costs for corn (silage, grain, sweet) the expected yield, the kind of rainfall, the green crop and the quality of the land were taken into account and they were analyzed by the following aspects taken into account: seeds, pesticides, fertilizer, diesel fuel, harvesting, transportation, cleaning / drying and wages.

The value of total expenditures for corn silage:	170-220 000 HUF/ha
The value of total expenditures for corn:	195-260 000 HUF/ha
The value of total expenditures for sweet corn: (non-irrigated / irrigated)	290 000 / 480 000 HUF/ha

Evaluating the specific income conditions for the year of 2015 was not easy in case of young farmers, as in the case of silage corn it was clearly stated that it covered the mass feed needs of their animals, so it was not sold, in the case of grain corn exclusively the surplus was sold, while in the case of sweet corn they only produced for sale. None of them made itemized cost calculation.

Specific income value of silage corn:	0 HUF/ha
Specific income value of corn:	130-170 000 HUF/ha
Specific income value of non-irrigated/irrigated corn:	180 000 / 250 000 HUF/ha

RESULTS

Income generating capacity of corn

The income producing ability of corn is expressed by a so-called EUME (European Units for Measurement) value derived from an SGM (Standard Gross Margin) value based on test farm income calculations. In the three-year 2007-2013 budget period in Hungary there were three tenders, while in 2014 and 2015 there were one tender each year, which were aimed to help start young farmers by up to € 40 000 HUF equivalent to 100% (90% + 10 %) support. financed by European Agricultural Fund for Rural Development. Neither the 2014 (ANONIM, 2015a) nor the 2015 (ANONIM, 2015b) tenders offered extra points for undertaking the production of corn exclusively, in plant production the sector investigated in our research, therefore extra points were not provided to win the tender. Tenders offered extra points for the winning young farmer to undertake the task of changing the composition of the production by the end of the fourth year of the operating period so that 84-100% will be animal husbandry, horticulture, or the two of them together.

The special situation of popcorn and sweet corn

The data-base of the test farms, referring to the extremely diverse field of use of corn and cultivation specificity, counted/evaluated the income generating ability accordingly. Thus, there are separate categories (see *Table 1*) in SGM test base.

Table 1. The calculation of the income-generating capacity of corn based on SGM operational tests

Code of item	Denomination	Unit	SGM
D06	Grain corn	HUF/ha	230 541
D18B1	Forage crops - other green fodder, silage corn	HUF/ha	226 031
D19	Reproduction material (seeds and seedlings)	HUF/ha	176 674
D14A	Fresh vegetables, melons, strawberries - open field and under low cover, arable crop rotation	HUF/ha	950 331

Source: Anonim, 2015b

Considering the income-generating capacity there is not too much difference between the grain corn with D06 code, the silage corn with D18B1 code and the D19 coded corn grown for seed purposes, while the production of sweet corn and popcorn cultivation (D14a) is regarded as fresh vegetable cultivation, therefore it has extremely high SGM value compared to the other corn sectors. None of the young farmers in our research produced seed corn, since their relatively small area of farming as well as the expected high isolation distances during cultivation did not allow that.
In addition to the fact that these two types of corn with D14a code have a high SGM value, and thus they have high profitability indicators, they are not included among the field crops. They belong to the horticultural sector. Consequently, the young farmers who undertake to include 84-100% of these high capital-intensive, cost-intensive cultivated plants into their production structure in the fourth year might receive significant additional scoring.

The relations between the profitability and the capital requirements of corn

The profitability tests usually analyse relations with some other categories. The most common and also one of the longest-studied correlations is the relationship between size and profitability. If the above relation is applied to agriculture, within that to arable crops and in this case to corn, then the large size ("Series Size") primarily applies to the production of grain corn, silage corn and corn seed; while ("specialization") refers to sweet corn and popcorn regarded belonging to the vegetable sector (MIZIK, 2004). Even with the help of the state subsidy programme called "Land for farmers" it is difficult for young farmers to purchase/lease land therefore the possibility of producing grain corn, silage corn and corn seed based on series size, as mentioned above, is limited at the beginning of the operation years. The production of sweet corn and popcorn, based on specialisation, provides better scoring and viability for young farmers although it is a higher capital-intensive investment because of tool requirement (irrigation) reasons.
The relationship between concentration and profitability is also a frequently studied context. Economically it is accepted that the higher concentrations are associated with higher profitability. In terms of corn production a more modern generation of young farmers are characterized by a powerful concentration.
There is an interesting theoretical relationship between young farmers' profitability and financial situation. From the creditors' side one essential condition for the return is the profitable operation, however on the other hand borrowing can be intended to create a profitable operation is (for example, by purchasing new technology or equipment it can be said that the profitably working young farmer's debt level is lower and they have higher liquidity of stock (cash, marketable securities) than a non-profitable business partner. In case of sweet corn and popcorn production based on specialization with high investment needs the creditors cannot assess the long-term history of the young farmers because they get the "young farmers status "only" for five years. Therefore creditworthiness assessment can be made within this time period (MIZIK, 2004).
The direct and indirect agricultural subsidy system must also be mentioned that make difference between the corn production sectors in the 2014-2020 budget period, focusing on the development of labour intensive sectors.

CONCLUSIONS

In case of the control at the end of the fourth year of the operating period the legislature must have recognized the relationship between corn production and consumption and as a result the income and capital demand conditions. This sector is a capital intensive, innovative sector that requires high concentration and professional knowledge, however the required input value is ensured on the long term by the diversity and marketability of the product offered for sale.
Through establishing an appropriate legislative background and scoring system for the tenders of young farmers it can surely be prevented that "forced corn growers" get among the candidates who do not consider the capital needs and income situation of crop production, as BENKŐ-KISS ET AL. (2010) also mentioned.
During the research it became clear that despite the progress achieved only a thin slice of the issue was discussed because of space limitations.

Other possible directions are many and diverse:

- Take into account other aspects; in case of different results explanations;
- extend the analysis for several years, strengthen the results and explore the different existing and potential trends (NAGY, 2012);.
- analysis of the results by international standards could provide further valuable insights;
- a separate study could be prepared on the non-human factors that affect both the profitability and the need for capital;
- it would be wise to examine the impact of the tax system, of subsidies and deductions in the segments concerned.

Also it would be instructive to demonstrate the impact of education, within that the part of agricultural expertise on the performance of the company.

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WATER REGIME CHANGE OF SURFACTANT POLLUTED SOILS

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ABSTRACT
Studies were made on the adsorption of a cationic surfactant, hexadecylpyridinium-chloride (CPC), on various soils and sediments. The aim was to determine how modify the adsorbed surfactant the soil physical characteristics, mainly water regime.
Water retention were measured, pore size distribution curves were derived from water retention curves, modal suction, total porosity and rate of different pores (macro-, meso-, micro-, ultramicro- and cryptopores) were evaluated. Due to CPC treatment, samples became hydrophobic. Rate of cryptopores declined at all surfactant treated samples, while rate of micropores were raised most of the samples. Except for two samples total porosity was decreased, as well. Kind of these changes can depend on differences in particle size distribution, calcium carbonate content, aggregate stability, quantity and quality of clay minerals. As pore size changes, amount of retained water also changes.

Keywords: soil, surfactant, water regime, pore size distribution

INTRODUCTION

Surface active agents, surfactants can reach environment mainly through waste water (due to cleaning supplies and detergents), numerous pesticide and fertilizers also contains surfactants as e.g. emulsifiers, wetting agents, adjuvants.
Their other application area is soil and groundwater remediation: depending on the type of pollutants (polar – non-polar) and contamination site (liquid – porous) different kind of surfactants are used (WEST AND HARWELL, 1992; SABATINI ET AL., 1996; SHENG ET AL., 1996; MULLIGAN ET AL., 2001; RASHID ET AL., 2004). In the meantime they can become co-pollutants (MULLIGAN ET AL., 2001).
Surfactants change several physical, chemical and biological soil properties depends on its type (DOBOZY ET AL., 1970; KUHNT, 1993). They have effects on infiltration, hygroscopicity, porosity (KUHNT, 1993; ABU-ZREIG ET AL., 2003), capillary rise (LAW ET AL., 1966; DOBOZY ET AL., 1970), water retention (KARAGUNDUZ ET AL., 2001), oil retention (CSATÁRI ET AL., 2013), aggregate stability (LAW ET AL., 1966; DOBOZY ET AL., 1970; PICCOLO AND MBAGWU, 1989; MIÓKOVICS ET AL., 2011) and hydraulic conductivity (ALLRED AND BROWN, 1994; RAO ET AL., 2006). They may also affect pH, redox potential, cation exchange capacity (KUHNT, 1993), activity of microorganisms, population composition, cell functions (DOBOZY ET AL., 1970; KUHNT, 1993; BANKS ET AL., 2014).
Pore size distribution curves can be derived from soil water retention curve (SWRC) RAJKAI ET AL. (2015). Modal suction is the matric potential at the peak of the specific

SWRC. MS corresponds to the most frequent pore size class of the soil. The higher the value of the MS, the smaller the size of the most frequent pores in the soil is.
In this research we measured the water retention capacity of a cationic surfactant treated samples, change in pore size distribution and so in total porosity was detected.

MATERIAL AND METHOD

The main characteristics of the samples are listed in *Table 1,* measured by Hungarian standards (BUZÁS, 1993). Particle size distribution was determined according to ISO 11277: 2009(E) method.

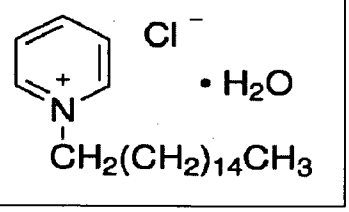
Table 1. Characteristics of samples

Sample code and *WRB Soil classification*	*Clay + Fe (%)*	*Silt (%)*	*Sand (%)*	*Humus (%)*	*$CaCO_3$ (%)*	*pH (dw)*	*hyl*	*CEC (mgeq/ 100 g)*	*SSA (m^2/g)*
(1) Vertic Stagnic Solonetz (clayic) (*Karcag*)	51.09	45.90	0.88	2.00	0.13	6.92	3.90	40.85	43
(2) Hortic Terric Cambisol (Dystric Siltic) A horizon (*Keszthely*)	20.99	33.13	44.28	1.55	0.05	7.04	1.24	11.84	11
(3) Hortic Terric Cambisol (Dystric Siltic) B horizon (*Keszthely*)	22.89	33.87	42.29	0.94	0.00	6.83	1.49	12.38	19
(4) Cutanic Luvisol (Siltic) A Horizon (*Várvölgy*)	15.27	29.35	54.05	1.33	0.00	6.59	1.07	10.36	10
(5) Cutanic Luvisol (Siltic) B Horizon (*Várvölgy*)	22.25	26.56	50.49	0.70	0.00	6.64	1.58	12.78	20
(6) Quartz sand (*Salföld*)	0.98	0.40	98.60	0.00	0.02	7.44	0.07	0.70	1.0
(7) Vertic Gleyic Luvisol (Mangani-ferric Siltic) (*Magyarzombatfa*)	38.96	25.93	34.61	0.49	0.00	5.74	2.22	16.78	30
(8) Loess (*Paks*)	16.08	46.00	9.25	0.63	28.04	8.17	1.02	19.74	12.0
(9) Vermic Calcic Chernozem (Anthric Siltic) (*Kápolnásnyék*)	27.60	51.68	7.50	3.70	9.52	7.83	2.25	30.25	14
(12) Gleyic Vertisol (Calcic) (*Kisújszállás*)	55.01	41.19	1.05	2.76	1.10	7.51	4.49	35.69	47

The applied cationic surfactant is hexadecylpyridinium-chloride monohydrate, or CPC (Sigma-Aldrich), used mainly in pharmaceutical and cosmetics industry due to its good antibacterial and fungicide properties (HRENOVIC et al., 2008). Its structural formula and other parameters are in *Table 2.*

Table 2. Major properties of hexadecylpyridinium-chloride monohydrate

Empirical formula	$C_{21}H_{38}ClN*H_2O$
Molecular mass (g/mol)	358.01
Water solubility(g/l) (20 °C)	50
Density (g/cm^3)	0.37
pH (10 g/l, H_2O, 20 °C)	5.0 – 5.4



Very few data are available in the literature on the CPC adsorption on real soil (LAW ET AL., 1966; BARNA ET AL., 2015b). The samples were treated with surfactant in the course of

static equilibrium experiments (FÖLDÉNYI ET AL., 2013). The specific quantity of surfactant required to make the adsorbents hydrophobic was determined based on the adsorption isotherms, assuming that a monomolecular surfactant layer was formed on the surface of the soil particles.

Since we experienced disaggregation and structure failure within the samples following the static equilibrium surfactant treatments we decided to also perform the treatment of samples with distilled water among identical conditions. Comparison of the two type of treatments was done (instead of control samples and surfactant treated).

Water retention capacity measurements were carried out with modified Soilmoisture Equipment Corporation LAB 23 porous ceramic plates, about 90 cm^3 artificial soil columns, at three repetitions. Rate of different pores (macro-, meso-, micro-, ultramicro- and cryptopores), total porosity were determined. We used grouping system of the SSSA (1997) to classify the pores. Equivalent diameters of the pore classes and corresponding matric potentials (log(*h*); cm) are as follows: macropores: > 75 μm, < 1.6 pF; mesopores: 30–75 μm, 1.6–2 pF; micropores: 5–30 μm, 2–2.78 pF; ultramicropores: 0.1–5 μm, 2.78–4.47 pF and cryptopores < 0. 1 μm, > 4.47 pF).

RESULTS

Due to CPC treatment samples became more hydrophobic, water vapour adsorption was declined, and water retention was decreased (BARNA ET AL., 2015a).

Change in modal suction is presented in *Figure 1,* either decreases or increases occur. The largest alteration was in case of Magyarszombatfa which has the highest swelling clay minerals content. At sample of Paks changes could be caused by high (>20%) calcium carbonate content.

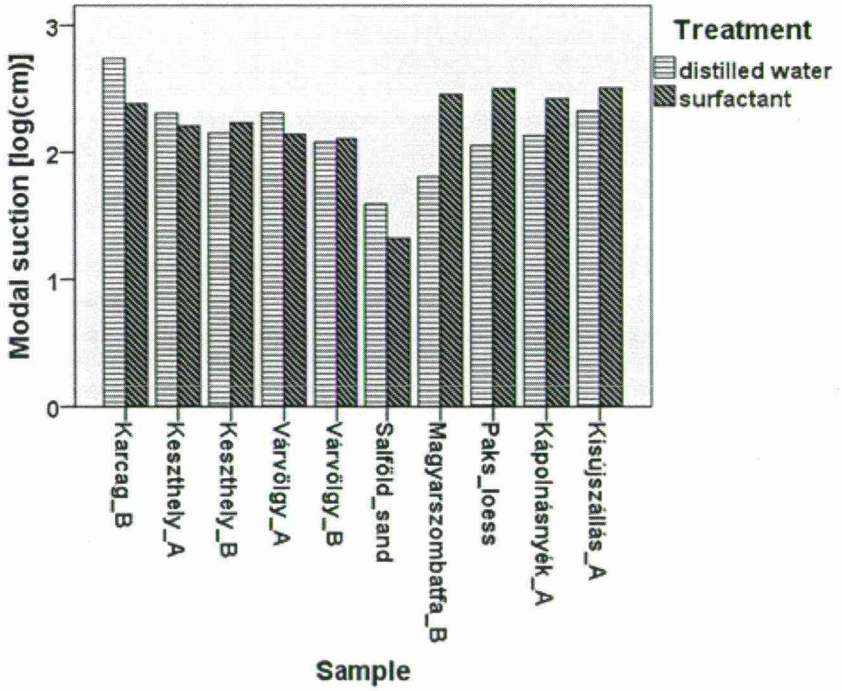


Figure 1. Change in modal suction

Alteration of the different type of pores due to surfactant treatment is shown on *Figure 2.* Rate of cryptopores declined at all surfactant treated samples, rate of micropores were

raised most of the samples, except for two samples. Pore size distribution curves become more peaky. At CPC-treated Karcag sample either rate of macro-, meso- and micropores,

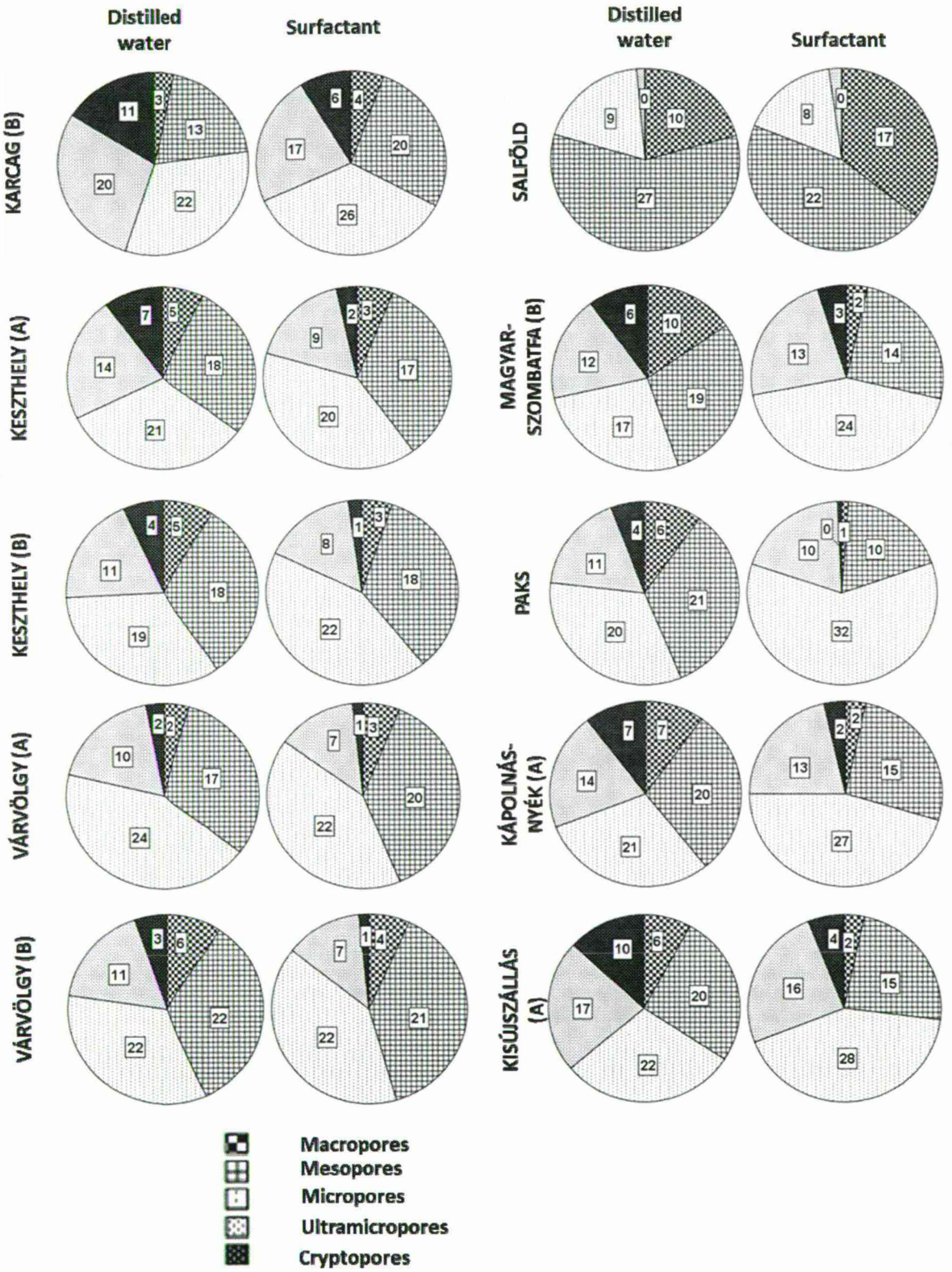


Figure 2. Rate of different pores (in volume%; amount is total porosity)

or total porosity (TP) became higher. All types of pores were less at Keszthely (A) sample, and TP decreasing was 14%. Keszthely (B), Paks, Kápolnásnyék and Kisújszállás samples rate of micropores decreased, other pores declined. Macro- and mesopores increased at

Várvölgy (A). In case of Várvölgy (B) only micropores did not change, the others were declined. Quartz sand sample has bigger pores and rate of macropores became larger, total porosity increased. Micro- and ultramicropores of Magyarszombatfa sample raised up.

CONCLUSIONS

Due to surfactant treatment samples became more hydrophobic, total porosity was decline. Usually rate of micropores was raised up, the other type of pores mainly decreased. These changes can depend on particle size distribution, aggregate stability, quantity and quality of clay minerals, calcium carbonate content. Surfactant molecules principally bounded to the surface of soil particles in a monolayer which might cause a smaller pore size diameter, as well. Dissolving CPC into the liquid phase can reduce the surface tension that can lead to change in capillary force. Change in pore size and in capillary forces effect the amount of retained water, so water regime.

ACKNOWLEDGEMENTS

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TECHNOLOGICAL RECOMMENDATIONS IN RABBIT PRODUCTION: SOME FACTORS OF HOUSING CONDITIONS

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ABSTRACT
In the last ten years a number of research were done and articles were published in order to improve or change the housing conditions of rabbits. These studies focus on the customer needs and changes in expectations based usually on animal welfare. During farm visits we found that the housing circumstances among those factors which are emphasized individually or jointly appeared in the everyday life of rabbit farming (for example: optimal micro-climate, cage floor space, type of floor, keeping mode, environmental enrichment, etc.). In our work we tried to determine the advantages and disadvantages of each procedure. In many cases it is difficult to create perfect coherence with the ideas of animal rights, animal needs and economic interests of the farmers. The number of results and ideas for implementation of all the correct procedures is so great that it is certainly impossible to keep them a time and place in a single technology. Of course, if the changes are generated by the consumer demands, then the farmer has to adapt to expectations in order to keep the market (and sometimes ignoring some other aspects).

KEYWORDS: rabbit, housing facilities, animal welfare, environmental enrichment

INTRODUCTION

In the last ten years a number of research were done and articles were published in order to improve or change the housing conditions of rabbits. These studies focus on the ethology of the rabbit, the European legislation, the customer needs and the changes in expectations based usually on animal welfare. The aim of the study was the summarization of some practical experiences and research result on housing facilities.

MATERIAL AND METHOD

During our study several farms of various sizes, visits of trade exhibitions and conversations with producers happened to our experience we compared the results of scientific literature. We were looking for a less favourable side benefit of certain technical and technological solutions. The pros and cons of the recommended methods in animals and/or the farmers' point of view we tried to present.

RESULTS

The housing conditions are very diverse in the Hungarian rabbit farming. The facilities are depends on the size of the farm, the capital supply, the traditions, the purpose and intensity of production, the legal regulation and on the applied technology. There is a coexistence of wooden or wire-mesh cages and pen housing; traditional feeding with hay, cereals and by-products with bottle drinkers and automated feeder and drinker systems; old barns and almost air-conditioned buildings.

Thus, the following general requirements for the housing of rabbits can be summarized as follows:

- no pain, no avoidable suffering and no injuries caused by housing;
- protection against predators and parasites;
- provision of feed and water according to the needs of rabbits (mostly *ad libitum*);
- protection against adverse climatic conditions;
- good hygiene in the rabbit house;
- a good handling of animals;
- from time to time use of "all in – all out" with cleaning and disinfection;
- environmentally enriched housing system (HOY, 2008)

The rabbits shall have permanent access to water of good quality. There has to be in minimum one nipple waterer per cage or pen in single housing. More than one nipple waterer should be used in groups of more than ten rabbits. The width of the feeding place has to be 6 to 8 cm, depending on the size of the rabbits, up to a live weight of 4 kg. For bucks the width of the feeding place should be 10 cm. If the rabbits are fed *ad libitum* the width of the feeding place can be reduced to half of the width.

Older technologies are often cheaper, but need more labour, while the new/modern systems are expensive and sometimes do not mean less labour (see welfare).

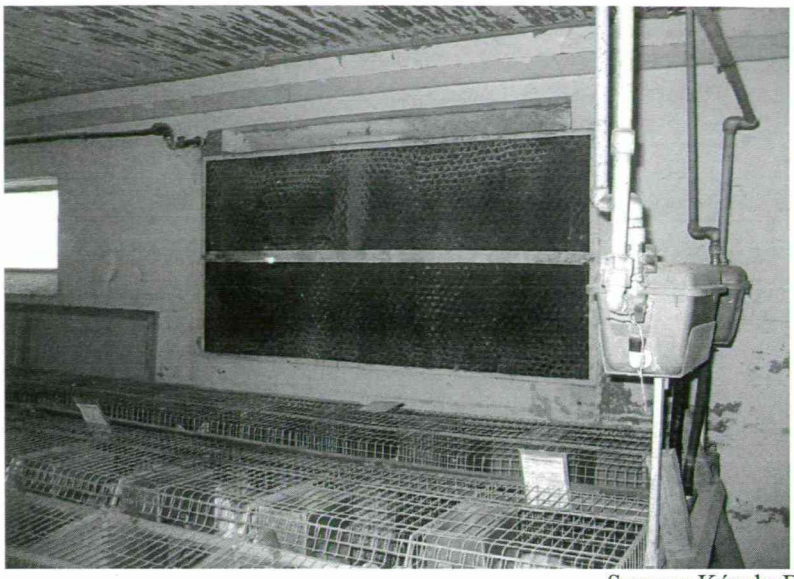
Microclimate

Temperature is one of the most important factors as it directly affects a number of elements. The optimal environmental temperature is 10-20 °C for production. Rabbits have a constant body (rectal: 38.5-39.0 °C) temperature so heat production and losses must vary to maintain body temperature. They do this by modifying their feed intake level. They use three methods to control heat loss: general body position, breathing rate and peripheral temperature, especially by ear temperature.

If the ambient temperature is low (below 10 °C) the animals curl up to minimize the total area losing heat and lower their ear temperature. If the temperature is high (above 25 °C to 30 °C), the animals stretch out so they can lose as much heat as possible by radiation and convection, and step up their ear temperature. The ears function like a car radiator. The efficiency of the cooling system depends on the air speed and humidity around the animal.

Due to the climate change the summers in Hungary often extreme hot, and the number of days over 30 °C are increasing. At environmental temperatures of 32 °C and higher heat stress occurs, leading to production losses. When temperatures of 35 °C and higher persist, the greatest losses from heat stress may result (EL-RAFFA, 2004). So the farmers should adapt technics against permanent heat stress. Appropriate advices could be given to avoid the heat stress on rabbits during the summer season. Some recommendations could be summarized as follows:

- Selecting a strain of rabbits that has shown the greatest degree of heat tolerance should be considered.
- Cool the drinking water.
- Using cooling panel to decrease room temperature (*Figure 1*).
- Adding vitamin C in drinking water.
- It is recommended to feed the rabbits during the coolest periods of the day, i.e. at early morning, late in the evening or by night which characterized with lower temperature and lower humidity in summer months.



Source: Károly Bodnár

Figure 1. Cooling panel in the wall

Rabbits are sensitive to very low **relative humidity** (below 55%) but not to very high humidity. This may be explained by the fact that wild rabbits spend much of their lives in underground burrows with a humidity level near saturation point (100 percent).
The rabbit has more to fear from sudden changes in humidity. Constant humidity is therefore the best solution, and this will depend on the housing design. Most of the breeders find 60-65% humidity levels successful, using only auxiliary heating in winter.
When the temperature is too high (close to the rabbit's body temperature) and humidity is also high, not much latent heat can be exported as water vapour through evaporation.
Air which is too dry (below 60% relative humidity) and too hot is even more dangerous. Not only does it upset the secretion of mucus but the ensuing evaporation shrinks the size of the droplets carrying infection agents, enabling them to penetrate more easily to the respiratory apparatus.

The rabbitry must have a certain minimum of **ventilation** to evacuate the harmful gases from urine and manure (e.g. NO_3, H_2S) or given off by the rabbits (CO_2), to renew the oxygen and get rid of excess humidity (evaporation, exhalation) and excess heat given off by the rabbits.
High ammonia air levels (20-30 ppm) greatly weaken the rabbits' upper respiratory tract and open the door to bacteria such as Pasteurella and Bordetella. To keep NH_3 levels down, ventilation can be increased. The risk is then overventilation, with all the negative consequences. A more effective solution is to limit NH_3 production from floor/litter (droppings and urine) by removing the litter quickly or keeping it dry. The measurement of NH_3 content in the air is difficult for farmers, so the simplest way of detection if the air is fresh and odourless inside the building.
To improve the quality of air pollutant emission management systems would be required (CALVET ET AL., 2012), especially if it would be of major interest to determine how different management practices (e.g., ventilation rates, feeding strategies and manure management) affect the emission of pollutants. Moreover, the characterization and quantification of air pollutants on rabbit farms is a necessary preliminary step that can contribute to design adequate reduction measures to control atmospheric pollutants (gases and solid particles), not only inside rabbit houses but also emissions into the atmosphere.

Illumination

There is a influence of light on rabbits, and these are almost exclusively concerned with the duration of lighting and seldom with light intensity. Practical recommendations on lighting are based more on observations in rabbitries than on experimental findings.

Exposure to light for eight out of 24 hours favours spermatogenesis and sexual activity in bucks. Conversely, exposure for 14 to 16 hours a day favours female sexual activity and fertilization. Performance is more constant in windowless rabbitries with artificial lighting than in buildings which supplement sunlight by artificial illumination.

Observations from different farms indicate that breeding does need considerable luminosity. In fact, many breeders who light their premises for 16 hours a day but not uniformly find that the does receiving the least light have the worst reproduction performance. When light distribution is made uniform, reproduction performance increase.

In Hungarian rabbitries lighting is provided by traditional bulbs or fluorescent tubes (spectrum usually: daylight type). The second one provides the necessary light intensity at a lower energy cost than incandescent lamps, but their installation cost is much higher.

In farms, the seasonal effects are limited when 16 h lighting is applied year around. Change of 8 h light to 16 h light eight days before insemination is effective to increase the receptivity and kindling rate (SZENDRO ET AL., 2016).

Cage size

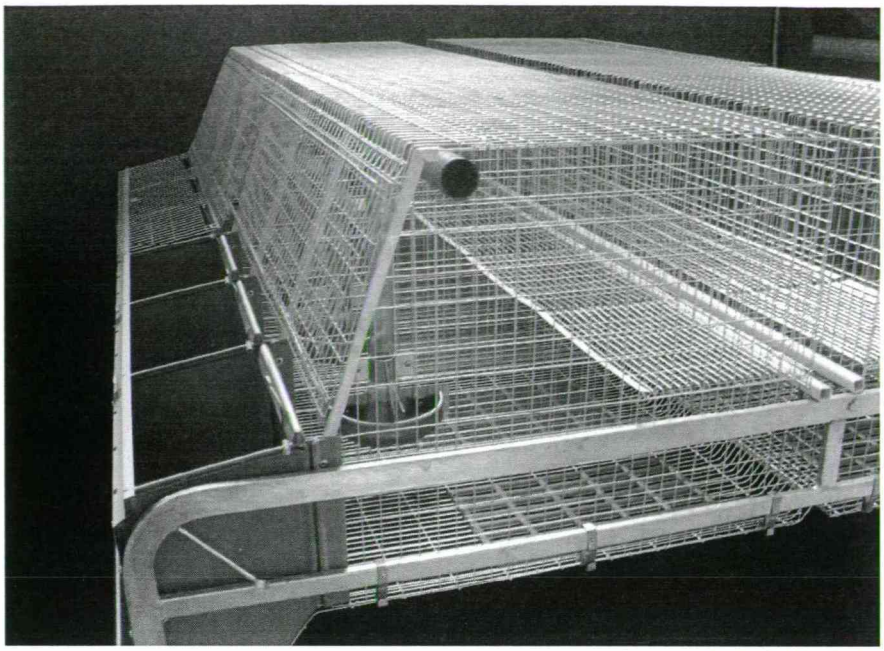
In practice there is a limit to the amount of space for animal accommodation in a farm facility, but it is important to try to optimize that which is available.

The non-pregnant rabbit does spent significantly more time (65%) in the larger cages every day. The cage choice showed the highest difference between the two cages between 23:00 and 5:00. It was the dark time period which was their active period (MIKO ET AL., 2012). The pregnant and lactating does spent most of their time (73.1%) in the larger cage. Although, parturition and lactation influenced the does' location preference, the effect of place (cage) of kindling was the largest on the cage choice.

It may be advantageous to change from caging to a penning system, which mayor may not be on the floor, with emphasis on environmental enrichment. Depending on the facility, small groups of rabbits could be kept in individual pens within an animal room, or larger groups could be housed in a stable. Even if this is not possible, it is very important to enrich the environment of the conventional single cage (*Figure 2*).

Floor type

In an experiment the floor of the pens was partly wire-mesh (1/3), plastic-mesh (1/3) and deep-litter (straw, 1/3). The rabbits showed the highest preference for plastic-mesh, at every age they spent more time there (70 and 52%, at the ages of 5.5 and 10.5 wk, respectively) than the expected value (33.3%) in case of random choice of floor type. Between the ages of 5.5 and 9.5 weeks the preference of the wire-mesh floor was significantly lower than 33.3% (20-27%), but at the age of 10.5 weeks it was not significantly different from value of 33.3%. Deep-litter was the least frequently chosen floor type at all ages (8 and 14%), at the ages of 5.5 and 10.5 wk, respectively.



Source: Károly Bodnár

Figure 2. Enlarged cage with wire mesh platform and plastic mesh pad

Similar tendencies were observed when the location preference was evaluated separately for the different day parts. Based on the results it can be concluded that at the temperature of 10°C the growing rabbits showed the highest preference for the plastic-mesh and the lowest preference for deep-litter, the preference of wire-mesh floor was a little lower than the expected value (33.3%) (GERENCSÉR ET AL., 2012).

The plastic pad must not obstruct the falling through of faecal drops and must be included in the cleaning and disinfection procedures. Enriched cages should be used allowing the rabbits to have access to material for engagement and – if possible – to an elevated platform. The elevated platform (the "third dimension") for breeding rabbits seems to be more important than an enlarged cage size. It allows the does to jump away from the kits. Lying in a stretched body position should be possible for all animals (HOY, 2008).

There are only a few farms apply pen with platform and litter on floor in rabbit husbandry in Hungary. One part of them belongs to a production system called Relaxrabbit, the others are small holders. This kind of production serves those consumers, who are willing to pay a higher price for "happy" rabbits, but usually the mortality and number of injuries are higher, the production/m^2 is less and labour requirement is bigger than in upgraded cage system.

Environment enrichment

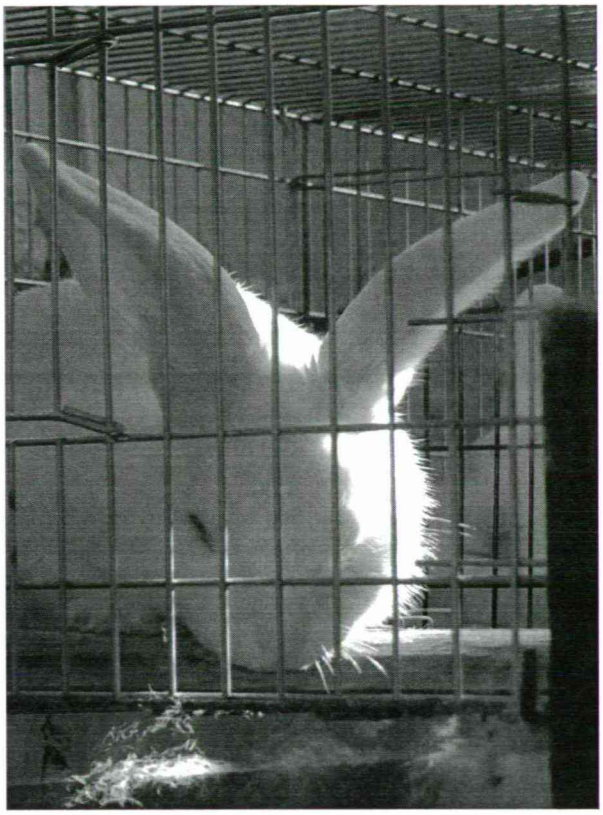
Environmental enrichment for rabbits could be done on several ways in pen or cage systems e.g. shelters, tubes, platforms, "toys", and materials to gnaw.

HANSEN AND BERTHELSEN'S (2000) results indicate that rabbits kept in an enriched cage system, particularly the females, had better welfare than rabbits kept in a conventional cage system because they had access to shelter and a better chance of interacting with the environment.

Farmers use for enrichment in classical wire-mesh cages hay, straw, carrot, apple, stale bread etc., not for their nutritional value but they give some activity for the animals and they have some stress relief effect. The addition of gnawing sticks either to individually

(JORDAN ET AL., 2008) or group housed growing rabbits resulted in significant decrement of biting wire.

The use of wooden stick is more and more popular (*Figure 3*). The breeders give them as sawn hardwood (fruit trees, ash, beech, oak, acacia, alder, maple, elm) however, they suggest the placement of leafy branches, too. Wooden sticks for gnawing made of spruce are not efficient environmental enrichment for growing rabbits housed individually in wire-mesh cages. In some cases the incidence of enterocolitis was higher when wooden stick was used (MIRABITO ET AL., 2000).



Source: Károly Bodnár

Figure 3. Rabbit doe gnaws a wooden stick

Research on the effect of the housing system on animal welfare is not yet sufficient to reach definitive conclusions on the best rabbit accommodation (TROCINO AND XICCATO, 2006). As far as fattening rabbits are concerned, group rearing is surely the best choice to satisfy rabbit social behaviour, even if optimal available surface and group size need to be further evaluated, also with a view to maintaining high final product quality. In reproducing animals, alternative housing systems, that permit does to separate themselves from their litters, should be developed as well as group rearing systems which prevent abnormal reproductive behaviour and guarantee kit welfare and survival.

Further investigation is also necessary on cage dimensions, equipment and floor types, to avoid abnormal behaviour and poor hygiene and health of kits and growing and reproducing rabbits. Although several aspects of housing and rearing systems appear easily modified in commercial breeding without serious effects on commercial results and offer guaranteed advantages for both rabbit and farmer in terms of improved welfare, health conditions and productivity, other changes could or should be applied with proven benefit to animal welfare at costs that might be repaid in terms of an improvement in the image of rabbit meat offers to consumers.

CONCLUSIONS

During farm visits we found that the housing circumstances among those factors which are emphasized individually or jointly appeared in the everyday life of rabbit farming (for example: optimal micro-climate, cage floor space, type of floor, keeping mode, environmental enrichment, etc.). In our work we tried to determine the advantages and disadvantages of each procedure. In many cases, it is difficult to create perfect coherence with the ideas of animal rights, animal needs and economic interests of the farmers. The number of results and ideas for the implementation of all the correct procedures are so great that it is certainly impossible to keep them a time and place in a single technology. Of course, if the changes are generated by the consumers' demands, then the farmer has to adapt to expectations in order to keep the market (and sometimes ignoring some other aspects).

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MEAT PRODUCTION OF DOMESTIC BALKAN GOAT KIDS

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ABSTRACT
The paper presents the investigation of slaughter results, i.e. meat production and correlation between slaughter traits of kids of Balkan goat breed. Results of the study of slaughter properties are presented in this paper, also correlation between certain measures on carcass established in 96 kids of Domestic Balkan breed (gender ratio 50:50), slaughtered at the age of 90 days. Average dressing percentage of warm carcass with head and offal of investigated kid population was 58.19%, whereas the value of the dressing percentage of cold carcass with head and offal was 45.19%.
Male kids had statistically significantly ($P<0.05$ and $P<0.01$) higher values of carcass mass compared to female kids. Data on established correlation coefficients between slaughter traits of Domestic Balkan kids reflect presence of highly positive and statistically significant ($P<0.001$) correlative dependence. Linear regression coefficients of pre-slaughter body mass of kids (0.41 to 0.99) indicate that this trait has very significant effect on all dressing percentages and carcass.
Considering the expression of slaughter traits in kids of Balkan breed, obtained results should be used for formulating of future programs designed to improve the production of meat from autochthonous goat breeds.

Keywords: kids, domestic Balkan breed, sex of kids, slaughter results

INTRODUCTION

No statistical records were kept concerning the number of Serbian goats and their breeding because the goat keeping in Serbia was banned for a long period of time. The number of kids and goats that are yearly slaughtered here is not negligible. However, they are not available on the market, since most kids and even grown up goats are slaughtered and consumed on the firms where they were raised. That is why Serbian market is poorly supplied with this type of meat. Over the last few years the interest for breeding these very useful domestic animals changed considerably in Serbia. The number of those who are trying to establish the goat production or to enlarge their herds is increasing. In some regions this trend is especially extensive. This indicates that an increased supply of the goat meat of all categories can be soon expected on our market. Apart from the legal standards defining the quality of the goat meat of all categories as well as the quality of the animals slaughtered, it would be necessary to prescribe some other details relative to the preparation of these animals for the market. Goat population in hilly-mountainous region of Serbia is mainly domestic Balkan goat of red to sorrel colour with black, white and spotted varieties (MEMIŠI AND BAUMAN, 2007). This is a dairy breed, for which it is characteristic that the front part of the carcass is less developed than the rear part, they are of rough constitution, resistant to diseases and with very modest requirements in regard to nutrition and care.

Since our literature lacks the reference on the fattening traits and the slaughter characteristics of the certain goat genotypes that are raised in Serbia (MEMIŠI, 2000), we wished to point to the fattening traits and some slaughter characteristics found in the kids of the domestic Balkan goat. An additional reason is that, up to now, the Balkan goat has participated, in a high percentage (about 40%), in the breeds composing the total goat population in our country (MEMIŠI AND BAUMAN, 2007; MEMIŠI ET AL., 1998).

MATERIAL AND METHOD

The research was carried out on the herds of the Balkan goat on the farms of individual breeders, over a three years' period. Four herds of the Balkan goat were used as a material, and their productive and reproductive traits were observed during two years. In the third year, the fattening ability was tested, i.e. the production of meat in the 96 kids (24 kids in each herd, the sex ratio was 50:50), that were slaughtered at the age of 90 days. Subsequent to slaughtering and primary carcass treatment, weight of warm carcass with head and offal was registered. After cooling period of 24h at the temperature of 0 °C to 4 °C, weight of cold carcass with head and offal was determined, as well as without head and offal.
Statistical analysis of data was done by application of several program procedures (Proc MEANS, Proc CORR, Proc REG) of the statistical program package SAS (*SAS 9.1.3, 2007*).

RESULTS

Table 1 gives the mean values for the weight of the warm and cold carcass with and without the head and offal, as well as the total yield of the meat of the kids slaughtered, separated by sex.

Table 1. Mean values and carcass yield values of Balkan breed kids

Traits	Mean x ± SD (n=96)	CV, %	Sex			
			Male		Female	
			x ± SD (n=48)	CV, %	x ± SD (n=48)	CV, %
BWBS, kg	13.31 ± 1.05	7.88	13.50 ± 1.11*	8.22	13.12 ± 0.97	7.39
WCWHP, kg	7.74 ± 0.51	6.58	7.86 ± 0.55*	6.99	7.62 ± 0.45	5.90
DPWCHP, %	58.19 ± 1.33	2.28	58.26 ± 1.33	2.28	58.13 ± 1.34	2.30
WCHCH, kg	7.41 ± 0.50	6.74	7.53 ± 0.53*	7.03	7.29 ± 0.44	6.03
DPCCHP, %	55.75 ± 1.23	2.20	55.83 ± 1.24	2.22	55.66 ± 1.23	2.20
WCHCHP, kg	6.01 ± 0.37	6.15	6.10 ± 0.39*	6.39	5.92 ± 0.32	5.40
DPCT, %	45.19 ± 1.31	2.89	45.23 ± 1.36	3.00	45.15 ± 1.27	2.81

BWBS- Body weight before slaughter; WCWHP- Warm carcass weight with head and offal; DPWCHP- Dressing percentage at warm carcass with head and offal; WCHCH- Weight at chilled with head and offal; DPCCHP- Dressing percentage at chilled carcass with head and offal; WCHCHP- Weight at chilled carcass without head and offal; DPCT- Dressing percentage of cold carcass; * P<0.05.

Coefficients of determination (*Table 2*) indicate that the percentage of variability of studied dressing percentage values was in range from 0.41 to 0.99, which confirms the effect of pre-slaughter body weight of kids on observed slaughter characteristics.

Table 2. Coefficients and significance of linear regression of pre-slaughter body weight on major slaughter traits of Balkan breed kids

Traits	R^2	F (1.94)	r	*p*
Weight of warm carcass with head and offal, kg	*0.99*	*1357.7*	*0.469906*	*0.00*
DP of warm carcass with head and offal, %	*0.44*	*76.768*	*-0.83383*	*0.00*
Weight of cold carcass with head and offal, kg	0.94	1406.1	0.458049	0.00
DP of cold carcass with head and offal, %	0.41	64.910	-0.74658	0.00
Weight of cold carcass without offal, kg	0.89	785.81	0.327852	0.00
DP of cold carcass without offal, %	0.51	97.332	-0.88297	0.00

DP - Dressing percentage

DISCUSSION

Data obtained on slaughter traits of Domestic Balkan goat can be compared to results obtained by other authors, but there are certain discrepancies considering the diversity in breeds, body masses and ages of kids included in trials.

The most significant results show that pre-slaughter body mass of Balkan breed kids at the age of 90 days in average was 13.3 kg, average dressing percentage of warm carcass with head and offal approximately 58.2%, whereas the average dressing percentage of cold carcass without head and offal was approximately 45.2%.

Higher values of dressing percentage were established in male kids compared to female kids. However, statistically significant differences ($p<0.05$) were determined in mass of cold and warm carcass with head and offal, as well as mass of cold carcass without offal.

Obtained results are in favour of the conclusion that with the decrease of pre-slaughter body mass higher values of dressing percentage are realized (BOLAZALI AND KUCUK, 2008). Lower values for dressing percentage of warm carcass (49.71, 49.27 and 48.78%) and hot carcass weights (6.78, 7.61 and 7.02 kg) in kids Hair Goat, Saanen×Hair Goat (F_1 and B_1) slaughtered at the age of 4 months, are reported by YILMAZ ET AL. (2009) and ARGUELLO ET AL. (2007) for dressing percentages in kids of different genotypes. Obtained results for mass of warm and cold carcass with and without head and offal, as well as value of dressing percentage of warm carcass of Balkan goat, are also similar to those established by BECERRIL – HERERRA ET AL.. (2006), in kids of Mexican Creole goat breed (59.27%). The authors state statistically significant correlation of 0.83 and 0.76 for certain slaughter traits such as mass of warm and cold carcass in relation to pre-slaughter body mass, which was slightly lower compared to results obtained in this research (0.97 and 0.95). MARICHAL ET AL. (2003), report similar values of dressing percentage in kids reared on Canary Islands. Considering the expression of slaughter traits in kids of Balkan breed, obtained results should be used for formulating of future programs designed to improve the production of meat from autochthonous goat breeds.

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EFFECT OF ROOTSTOCK ON REFRACTION OF FORCED FRESH PEPPER (*CAPSICUM ANNUUM* L.)

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ABSTRACT
Fresh pepper (*Capsicum annuum* L.) production has a great tradition in Hungary. In 2014 fresh pepper was forced on 1600 ha, which reached approximately a 10 kg/m^2 yield. While in case of tomato, which belongs to the *Solanaceae* family, the use of grafted plants is relevant today, the practice of grafted plants in the cultivation of hungaricum fresh pepper is a not so known and used method. Therefore, the main objective of the experiment was to study the qualitative changes in response to grafting and to determine the appropriate rootstock - scion combination. The experiment was set up in unheated plastic house at the research garden of Szent István University in Soroksár. Combination of two fresh pepper varieties *SV 9702* (white type) and *Karpex* (kapia type) and two rootstocks *Snooker* and *Capsifort* were tested in soil and soilless culture. For soil culture the soil of the plastic house and for the soilless culture coconut fiber slabs was used. Grafted and non-grafted white type fresh peppers were placed at a row width and plant spacing of 110+40 x 33 cm (4 plants per m^2) while kapia at 110+40 x25 (5.3 plant per m^2). After the picking the Brix content was determined at the analytical laboratory of the department. From each repeat, 6 fruits were blended and measured with manual digital refractometer (PAL-1, ATAGO). After our studies both *Snooker* and *Capsifort* rootstock are recommended in combination of *SV 9702* white type and *Karpex* kapia type fresh pepper in soilless culture.

Keywords: fresh pepper, rootstock, grafting, forcing, brix

INTRODUCTION

Fresh pepper (*Capsicum annuum* L.) production has a great tradition in Hungary. In 2014, fresh pepper was forced on 1600 ha, which reached approximately a 10 kg/m^2 yield. Furthermore its open field production is also significant. The spread of plastic houses and the monoculture led to the increase of grafting vegetable crops around the 1960s (NAGY, 2005).

In Hungary and also in the world, the soil salinity causes problems, while most species of grown vegetables, especially fresh pepper, are salt sensitive. According to FAO data, 6% of the world's soil is salt-sensitive. In our country mainly the high salt content of the irrigation water cause harmful salt accumulation in soils. Through the accumulated salt the plant can absorb less water, hereby the nutrition uptake decreases (BALÁZS, 2011).

Nowadays, grafting has been increasingly popular in the production of vegetables. According to literature data, the practice of grafting has increased significantly in the recent years in abroad. In some Asiain countries grafting enjoys great popularity and nowadays the Europian countries are also increasing the demand for grafted seedlings (LEE, 1994; FERNÁNDEZ-GARCIA ET AL., 2004). By the use of rootstock, the tolerance to low (BULDER ET AL., 1990) and high temperatures can be increased (RIVERO ET AL., 2003). The aim of the producers, which is an effective long-term field utilization, is often intersected by soil borne diseases and pests against which the solution is soil disinfection, soilless cultivation and grafting (POGONYI AND PÉK, 2004). Grafted transplant shows better reaction to low soil temperature and high soil salt content (EDELSTEIN, 2004). Latest

studies proved, that the abiotic stress tolerance of grafted fresh pepper improved (PENELLA, 2014).

According to GARNER (1979), grafting has mainly three disadvantages, which are the incompatibility, costliness and possible quality loss. It is important to note that the quality loss occurs commonly because the producers do not take account the changed water and nutrition demand of grafted plants (SEDLÁK, 1993).

While in case of tomato, which belongs to the *Solanaceae* family, the use of grafted plants is relevant today, the practice of grafted plants in cultivation hungaricum fresh pepper is not so known and used method. Therefore, the main objective of the experiment was to study the refraction changes in response to grafting and to determine appropriate rootstock - scion combination.

MATERIAL AND METHOD

The experiment was set up in unheated plastic house at the research garden of Szent István University in Soroksár. Combination of two fresh pepper varieties *SV 9702* (white type) and *Karpex* (kapia type) and two rootstocks *Snooker* and *Capsifort* were tested in soil and in soilless culture. For soil culture the soil of the plastic house, and for the soilless culture coconut fiber slabs were used. Non-grafted and grafted transplants were planted out in 4 repeats in 18th May using intensive technology (soil mulch, dripping tube/dripping irrigation system, training system). *Table 1* contains the sowing date of seeds for grafted and non-grafted transplants.

Table 1. Sowing and grafting dates (2015)

Grafted	**Peat**	**Rockwool**
scions	20.03	27.03
rootstock	18.03	25.03
Graftingdate	23.04	28.04
Non-grafted	**Peat**	**Rockwool**
SV 9702/ Karpex	27.03	03.04

Grafted and non-grafted white type fresh pepper were placed at row width and plant spacing of 110 + 40 x 33 cm (4 plants per m^2) while kapia at 110 + 40 x 25 (5.3 plants per m^2). During the growing season two main stem was evolved twisted constantly to the training system and slightly pruned. In case of the white type, the fruits were harvested in economic ripeness seven times (14th July, 23rd July, 30th July, 6th August, 13th August, 25th August, 8th September), while the kapia type in biological ripeness 5 times (25th August, 3rd September, 10th September, 28th September, 20th October). After the picking the refraction was measured at the analytical laboratory of the department. From each repeat 6 fruits were blended and measured with manual digital refractometer (PAL-1, ATAGO). The results granted in °Brix.

RESULTS

After all pickings, the Brix content was determined at the analytical laboratory of the department by manual digital refractometer. From each repeat 6 fruits were blended and measured. After the average refraction values were calculated (*Figures 1-4*).

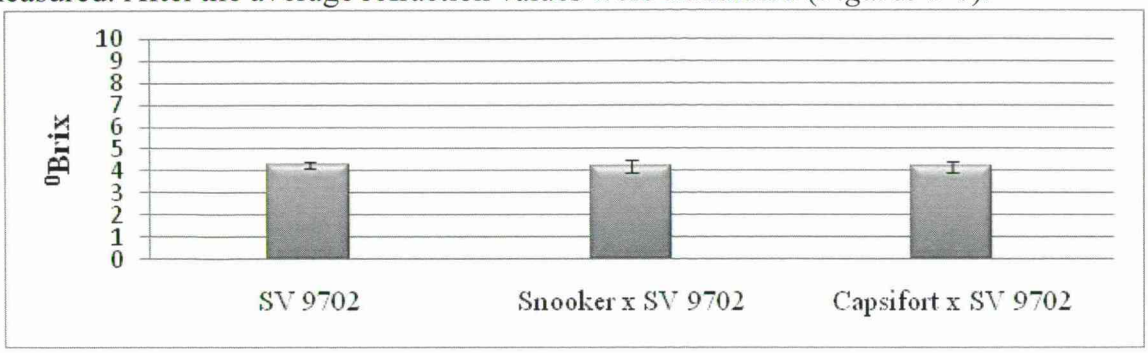

Figure 1. Refraction of white type fresh pepper in soilless culture (2015)

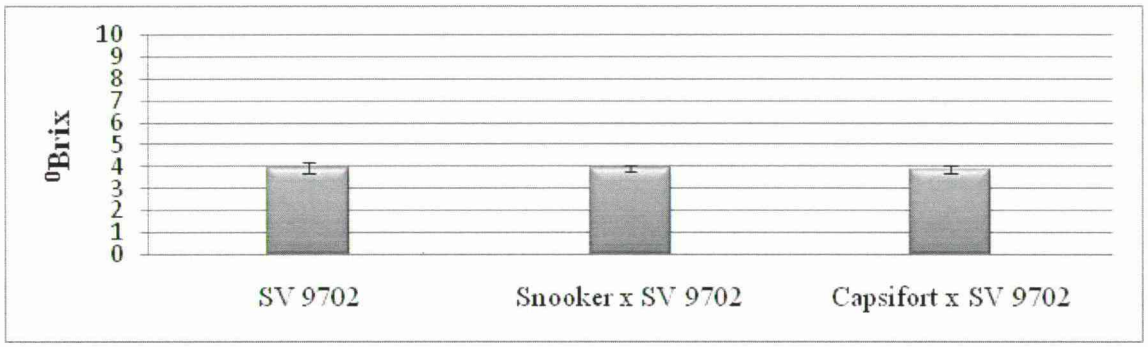

Figure 2. Refraction of white type fresh pepper in soil culture (2015)

Based on the results, it can be seen, that the refraction of white type fresh pepper was higher in soilless culture than in soil culture. Both in soil culture and in soilless culture, there were no significant differences in refraction detected between the grafted and non-grafted plants. The graft combinations *Snooker x SV 9702* and *Capsifort x SV 9702* had the same refraction on the different growing medias (*Figures 1-2*).

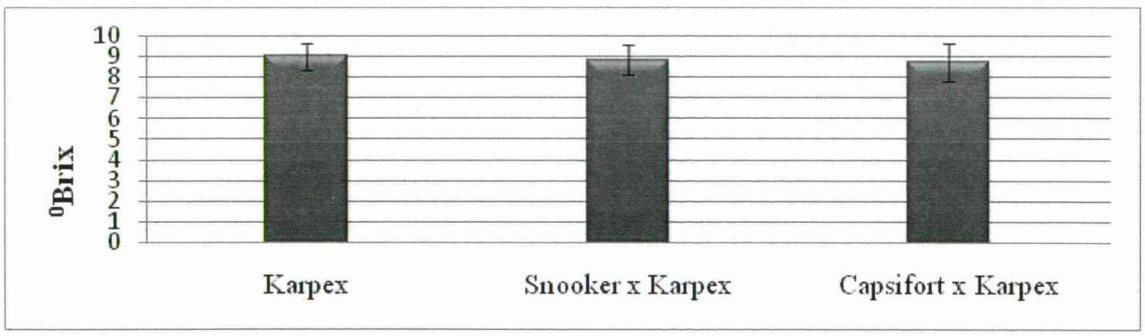

Figure 3. Refraction of kapia type fresh pepper in soilless culture (2015)

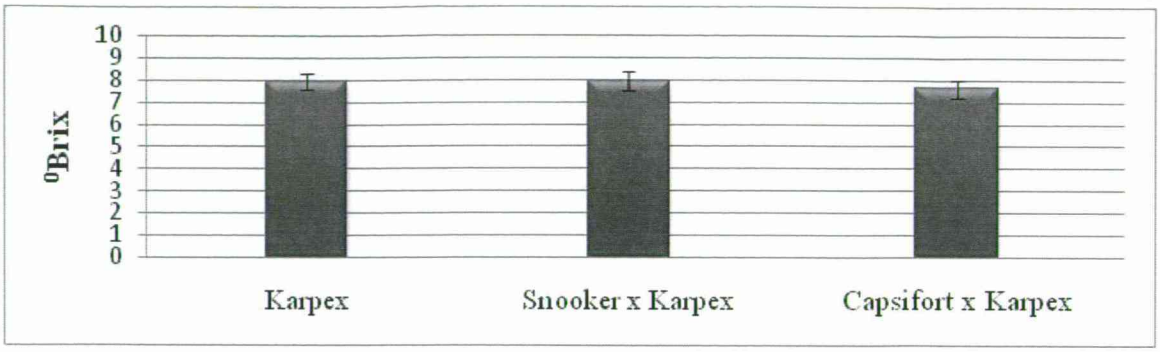

Figure 4. Refraction of kapia type fresh pepper in soilless culture (2015)

In the case of kapia type fresh pepper, grafting had no significant effect on refraction both in soil and soilless culture. In soilless culture, higher refraction was measured than in soil culture. The difference is approximately 10%. On both growing media *Capsifort x Karpex* showed lower refraction than *Snooker x Karpex* and own rooted *Karpex (Figures 3-4)*.

CONCLUSIONS

During the measurement of refraction from the average Brix value were determined that due to grafting slight decrease occurred, both in soil and soilless culture. Between the grafting on different rootstocks *Snooker* and *Capsifort* resulted the same which can be explained that both rootstocks have approximately the same effect on the scions.
Although the summer of 2015 was hot, it had no effect on the Brix values of the pickings.
Soilless culture has nowadays many advantages (higher yield, no disinfection from soil) and disadvantages (high labour). While it has higher investment cost in the case of both varieties, soilless culture is recommended.
Grafting of fresh pepper is increasing. Many varieties are present on the market but there are limited rootstock varieties. After our studies both *Snooker* and *Capsifort* rootstock are recommended in combination of *SV 9702* white type and *Karpex* kapia type fresh pepper.

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EFFECT OF HIGH HYDROSTATIC PRESSURE AT 400 MPA ON QUALITY ATTRIBUTES OF LIQUID EGG PRODUCTS

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ABSTRACT
Samples prepared from liquid egg yolk (LEY), liquid egg white (LEW) and liquid whole egg (LWE) were processed by high hydrostatic pressure (HHP) using different holding times (60, 180, 300, 420 and 600 s). The aim of our experiment was to examine how different holding times influences technofunctional attributes of liquid egg products.
The color of samples changed after 60 s HHP treatment, but visible changes were evaluated just after 180-300 s. The pH of samples was stable, there were no significant changes caused by HHP (one-way ANOVA, α=0,05).
The apparent viscosity was measured by a rotational viscometer as a function of shear rate. The shear-thinning behavior of LEY and pseudopastic behavior of LEW and LWE were fitted well into Herschel–Bulkley model (with a satisfying correlation of $R^2 > 0.96$). For the selected shearing rate, viscosity was measured in relation to shearing time. Thixotropic behavior of samples was increased by longer holding time of HHP treatments.

Keywords: high hydrostatic pressure, egg products, viscosity, technofunctional properties

INTRODUCTION

Eggs have been classified as nature's original functional food (HASLER, 2000). In present there is a tendency to use more and more eggshell processed products where term egg products refers to eggs that are removed from their shells (DE JESÚS ET AL., 2013).
Hen's egg yolk is an important ingredient of a wide variety of food products. In addition to its excellent emulsifying activity, its ability to form gels when heated is the basis of major applications of egg yolk. This characteristic property originates from protein interactions (KIOSSEOGLOU AND PARASKEVOPOULOU, 2005) and is decisive in determining the desired rheological and textural characteristics of foods such as bakery products, egg-based sauces, omelets, confectionery, etc. However, in thermally treated products such as pasteurized liquid egg yolk, gel network formation can cause unpredictable structure changes through protein denaturation (KIOSSEOGLOU AND PARASKEVOPOULOU, 2005) than egg yolk proteins are particularly thermosensitive (ANTON, LE DENMAT, BEAUMAL, & PILET, 2001). These changes can occur undesirably during pasteurization, food processing, and preparation, leading to a loss of product fluidity. Changes in thermally induced egg yolk gels can be provoked by different technological factors e.g. pH (CORDOBÉS ET AL., 2004; KIOSSEOGLOU AND PARASKEVOPOULOU, 2005). Knowledge of the influence of these factors makes it possible to apply them advantageously to obtain foods with an optimal texture and extended shelf life. Whereas several references are available on the influence of pasteurization, freeze-drying, and salts on the properties of egg yolk gels, the mechanisms are not completely understood by which these treatments induce the

conformational changes in the secondary structure of egg yolk proteins which are causally involved in gel formation (BLUME ET.AL., 2015).
The changes of rheological properties significantly related with flow transport of liquid egg product. It is important knowledge of flow velocity profiles in real tubes and pipes, which are used to transport, cooling, drying, and pasteurization. Part of this problem is described in (de SOUZA AND FERNÁNDEZ, 2013). Most of these studies have been usually carried out with only egg yolk. There is a lack of information about the rheological behaviour of liquid egg white and whole egg at different temperature range (TELIS-ROMERO ET AL., 2006).
The use of eggshell processed products (e.g. boiled eggs, liquid whole egg, liquid egg yolk and liquid egg white) is widely expanded in food industry because of easier utility, better food safety. Technofunctional properties of liquid egg products, like color, viscosity, foaming ability have extraordinary importance in terms of further industrial processing. Native attributes of egg products are expected by food producers, therefore minimal processing techniques of food preservation are constantly under development. One of the most prosperous methods is high hydrostatic pressure (HHP). HHP is a nonthermal preservation technology using hydrostatic pressure between 100 and 1000 MPa in food preservation. The aim of our experiment was to evaluate effects of holding time, as a parameter of HHP treatment.

MATERIAL AND METHOD

Sample preparing

Samples were taken from processing line of Capriovus Ltd. We used homogenized liquid whole egg (LWE), liquid egg yolk (LEY) and liquid egg white (LEW). From every product 500-500 ml of samples were packaged in PE bags. Samples were treated on 400 MPa in RESATO FPU 100-2000 laboratory HHP equipment with holding times: 30, 180, 300, 420 and 600 s at room temperature. Samples were stored at 4-6 °C before measurements.

Color

Minolta Cr 200 colorimeter was applied to evaluate color of samples. From L*, a* and b* (CIE-Lab color system) color difference ΔE_{ab}^{*} was counted to compare color of samples to control, untreated product. Differences in color were analyzed statistically with one way ANOVA and post hoc tests (SPSS 20.0 software, α=0,05).

pH-value

The pH of egg products was controlled with Testo 206 pH-meter. Statistical analyze of pH was carried out with one-way ANOVA (SPSS 20.0 software, α=0,05).

Rheological properties

In Department of Food Preservation rheological attributes were measured with Anton Paar Physica MCR 51 rotational viscometer at 5 °C. Shear stress was measured in function of shear rate, Herschel-Bulkley model and thixotropy of samples were evaluated.

RESULTS

Color

LEW became brighter (L* increased) affected by longer holding time. Color factors a* and b* in case of LEW were not significantly influenced, but changes in color of samples were

visible after 180 s HHP treatment. Statistically significant differences were evaluated after 180 s to control and between treated samples treated with longer holding time.
LEY's color became brighter (L* increased) such b*, namely yellow color became stronger. Changes increased effected longer holding time. In case of a* growing of value was experienced (60 s) but HHP with longer holding times resulted a* values like control's. There were statistically significant differences already after 60 s HHP treatment. In color of LWE there were a tendency, like in case of LEY: color of 60 s treated sample showed significant differences values. Longer holding times influenced less color of LWE.

pH

In case of LEY there were no changes, pH was measured between 5,49 and 5,66 pH of LEW showed a similar stability. The pH of LWE was only significant influenced by HHP treatment with 60 and 180 s, pH changed between 4,5 and 5,0.

Rheological properties

The apparent viscosity was measured by the rotational viscometer as a function of shear rate. Yield curves of control and 600 s treated samples are shown in *Figure 1* (LWE), *2* (LEW) and *3* (LEY). As it can be seen apparent viscosity and yield curves are changed effected by HHP treatment (treated samples are more "viscous"). Longer HHP treatment resulted higher differences and already 60 s HHP treatment changed rheological properties significantly.

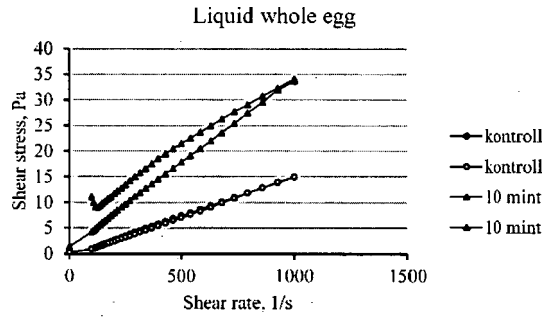

Figure 1. Yield curve of LWE control and 400 MPa, 600 s treated samples

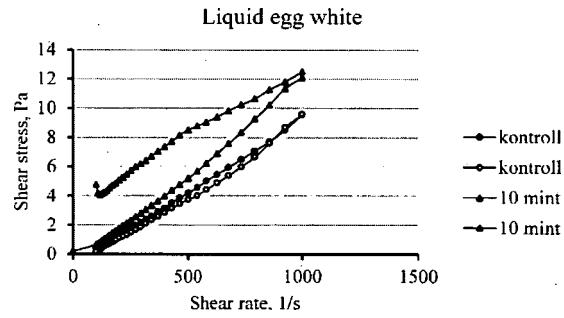

Figure 2. Yield curve of LEW control and 400 MPa, 600 s treated samples

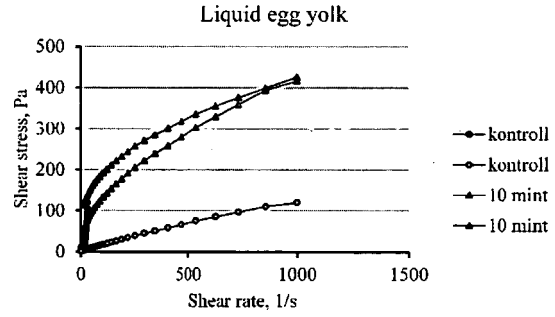

Figure 3. Yield curve of LEY control and 400 MPa, 600 s treated samples

Herschel-Bulkley model was applied to evaluate rheological results. *Table 1* shows n [-] flow behavior index of samples. Control LWE can be accepted as almost Nemwtonial fluid, longer HHP treatment caused increasing pseudoplastic attributes. LEW's n parameter decreased by longer HHP processing, but after 600 s it was pseudoplastic fluid. In case of egg yolk flow behavior index was not influenced by HHP, LEY can be considered as a gear-thickening fluid.

Table 1. Flow behavior index of HHP treated liquid egg samples at 400 MPa

n	LWE		LEW		LEY	
HHP	average	st. deviation	average	st. deviation	average	st. deviation
control	0,933	0,018	1,150	0,049	0,757	0,005
1 min	0,856	0,035	1,516	0,017	0,757	0,005
3 min	0,856	0,035	1,646	0,037	0,757	0,005
5 min	0,757	0,005	1,412	0,062	0,757	0,005
7 min	0,757	0,008	1,412	0,149	0,757	0,005
10 min	0,748	0,022	1,024	0,068	0,757	0,005
n=1 Newtonial fluid		n<1 pseudoplastic		n>1 shear-thickening		

The shear-thinning behavior of LEY, pseudoplastic behavior of LEW and LWE were fitted well into Herschel–Bulkley model (with a satisfying correlation of $R^2 > 0.96$). For the selected shearing rate, viscosity was measured in relation to shearing time. The time-dependent viscosity decreased rapidly with time and, at lower share rates, reached an equilibrium state. The time-dependent viscosity was also found to increase with holding time.

Table 2. Thixotropic behavior of liquid egg samples

A [Pas]	LWE		LEW		LEY	
thixotropy	average	st. deviation	average	st. deviation	average	st. deviation
control	378,17	43,72	418,02	46,68	100	0,00
1 min	4146,39	5,74	816,32	34,52	13254,50	341,08
3 min	4146,39	5,74	1319,52	31,89	17757,84	3691,56
5 min	3898,72	54,92	1945,01	13,80	24805,85	258,72
7 min	3244,47	58,50	2081,22	12,86	31688,03	349,83
10 min	2959,08	14,24	2380,13	183,09	40303,48	959,64

Thixotropic behavior of samples is shown in *Table 2*. In every sample there is the phenomenon that is caused by mechanical stress. HHP treatment increased thixotropy in every case. Application of longer holding time caused increasing thixotropy. HHP caused heavier mixable or flowable samples.

CONCLUSIONS

HHP treatment at 400 MPa can be an opportunity to preserve liquid egg products combined with other minimal processing e.g. heat treatment with low temperature. Knowing the impact of holding time on different technofunctional properties, like color or viscosity has outstanding importance because of industrial applications and processing.

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EFFECTS OF HHP PROCESSING AT 400 MPA ON PROTEINS OF LIQUID EGG PRODUCTS

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ABSTRACT
In food preservation technologies there are pursuits to apply minimal processing technologies which don't influence product quality attributes like protein structure.
High hydrostatic pressure (HHP) is one of the minimal processing technologies. The effect of high hydrostatic pressure (HHP) was studied at 400 MPa 600 s on proteins of liquid egg products (egg yolk, LEY and whole egg, LWE). Thermo-physical, calorimetrical properties were examined on Micro DSC III (differential scanning calorimeter).
Our result show that whole egg's proteins are not desaturated by HHP, but 40% of egg yolk's proteins had denaturation caused by processing.
Aggregation and separation of protein groups can be observed by both products. Changes in protein structures caused texture modifications.

Keywords: high hydrostatic pressure, egg products, protein denaturation, minimal processing

INTRODUCTION

After the II World War egg production launched a sharp increase that shows nowadays a growing trend too, estimated in 2015 volume of production may be greater than 72 million tons that means 1260 trillion pieces of shell eggs (DEUTSCHE STIFTUNG WELTBEVÖLKERUNG, 2009; FAO, 2005). The growing demand justify the development of new products which are easy to store and use, have extended shelf-life and are fully satisfying the aspects of food safety.
Traditionally, eggs are marketed as shell eggs, but in recent years, egg consumption in the form of egg products has increased. These products can be classified as refrigerated liquid, frozen, and dried products (DE JESÚS ET AL., 2013). Often we crash the problem by heat treatment of egg products, that there may be surviving microorganisms which can multiply in refrigerated storage. We can solve this problem with combination of HHP and heat treatment based on research results (PILAVTEPE ET AL., 2008; WANG ET AL., 2013).
Non-thermal processes might be an excellent alternative to overcome the problems associated to the changes in egg functional properties (DE SOUZA ET AL., 2015). Similar to thermal pasteurization, non-thermal pasteurization of eggs is challenging and despite substantial efforts, and none of the non-thermal technologies has been commercialized for liquid egg products, like pulsed electric fields (WONG ET AL., 1996), electron beam radiation and gamma radiation, or high hydrostatic pressure (PONCE ET AL., 1998, AMIALI ET AL., 2006).
The aim of the present paper is to study the effect of HHP treatment of liquid egg products (liquid whole egg LWE and liquid egg yolk LEY) at 400 MPa, 600 s. Protein structure, agglomeration and denaturation are inspected

MATERIAL AND METHOD

Sample preparing and HHP processing

Samples were taken from processing line of Capriovus Ltd. We used homogenized liquid whole egg (LWE) and liquid egg yolk (LEY). From every product 10-10 ml of samples were packaged in PE bags. Samples were treated on 400 MPa in RESATO FPU 100-2000 laboratory HHP equipment with holding times: 30, 180, 300, 420 and 600 s at room temperature. Samples were stored at 4-6 °C before measurements. Rising of pressure was in every case 100 MPa/60 s, on a RESATO FPU 100-2000 HHP equipment. Treatment and measurements were at Szent István University Faculty of Food Science, Department of Refrigeration and Livestock Products Technology and Dept. of Food Preservation.

Thermo-physical measurements

Thermo-physical, calorimetrical properties were examined on Micro DSC III (differential scanning calorimeter). In each case approximately 745.5 mg of samples were taken, reference was distillated water. Speed of heating was 1.5 °C/min, temperature of measuring was 95 °C and speed of cooling was 1.5 °C/min, controlled by SetSoft2000. Callisto 7.6 software was used to evaluate DSC thermograms (*Figure 1*).

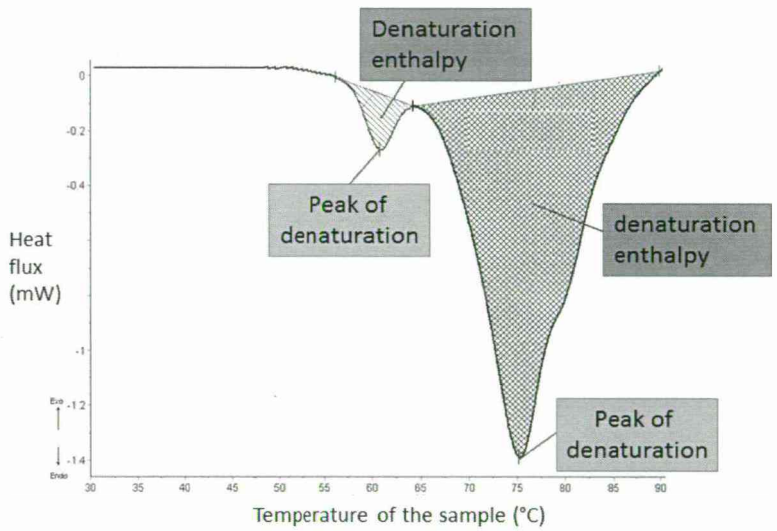

Figure 1. Overview of a thermogram

RESULTS

In thermograms of egg products control and 400 MPa, 600 s processed samples are shown to make an easier overview of results. In *Figure 2*, there can be observed that areas below the curves are from the same size: therefore there was no protein denaturation during 400 MPa and 600 s HHp treatment of liquid whole egg. The shapes of the curves are different, it suggests that HHP processing caused protein aggregation and restructuration between 70 and 80 °C. In protein fraction of conalbumin (55-60 °C) there were no changes.

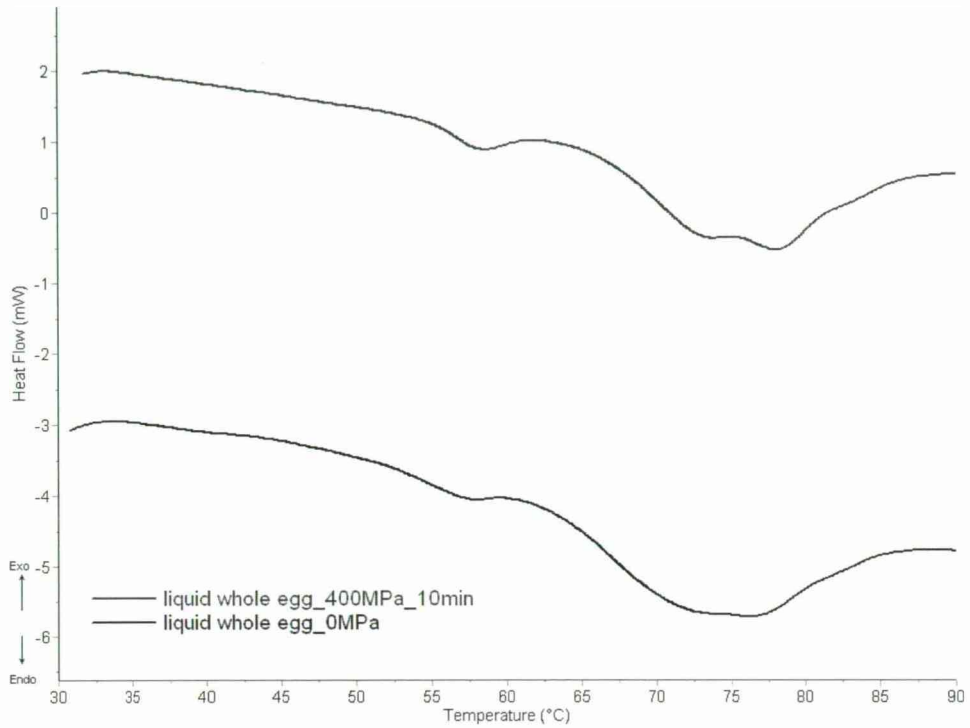

Figure 2. Thermogram of liquid whole egg control and HHP treated (400 MPa, 600 s)

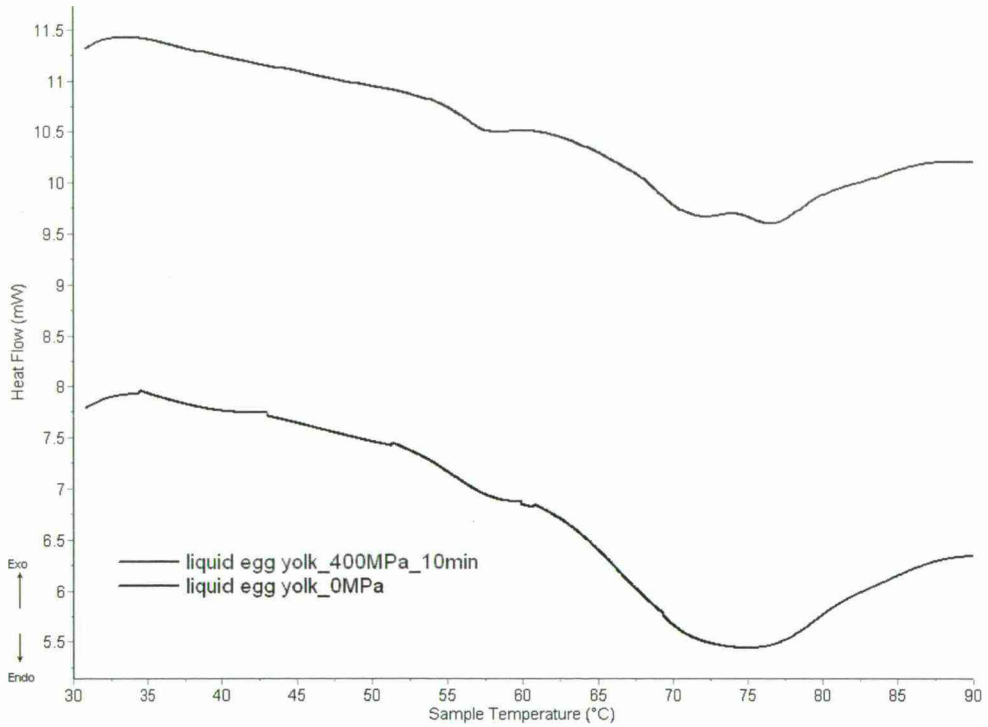

Figure 3. Thermogram of liquid egg yolk control and HHP treated (400 MPa, 600 s)

In *Figure 3* there can be seen the thermogram of liquid egg yolk. In case of egg yolk that areas under the curves are different: HHP treated sample's curves area decreased 40%. Decreasing of area means that there is denaturation of proteins in egg yolk. The main differences between the curves are at 70-80 °C. Proteins were fragmented. These fractions

are ovalbumin according to references. Appearing of peaks in thermograms leads to the conclusion that HHP treatment may cut by Proteins.
Viscosity and texture of samples were influenced by HHP: after 600 s egg yolk became spreads, viscous. Liquid whole egg showed the same changes, but only in a smaller extent. Rheological changes of samples indicate that there were protein aggregation and structural changes of proteins can be appeared.

CONCLUSIONS

In our study is shown that HHP treatment of liquid whole egg and liquid egg yolk influences the protein structure and may cause denaturation. The changes of proteins can be observed in thermograms and in texture attributes. Proteins in egg have big importance in processing and quality of food products.

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THE EFFECT OF FOLIAR FERTILIZATION ON THE YIELD AND GENERATIVE FACTORS OF MAIZE

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ABSTRACT
We examined the effect of different foliar fertilization products on the yield and generative factors of maize in 2015. The experiment was set in three repetitions, random blocks on the area of Tangazdaság Ltd. in Hódmezővásárely. The soil of the experiment was meadow chernozem. Soil analysis data showed that it had had good nitrogen, and very good phosphor and potassium contents. During the experiment we applied two times foliar fertilization. The year 2015 was unfavourable for corn production. In 2015 the amount of precipitation in the vegetative period of corn was lower by 83.4 mm than the average. The average temperature showed a positive deviation compared to the average of several years. We processed the obtained data by single factor variant analysis. The yield of the control treatment was 6.39 t/ha, the yields of the foliar fertilization plots ranged between 6.5-7.5 t/ha. The foliar fertilization products increased the yield of corn, but this difference was not significant. By the application of foliar fertilization the generative factors of corn did not change significantly.

Keywords: corn, nutrient supply, foliar fertilization, yield, generative factors,

INTRODUCTION

Today, in order to achieve high yields, cultivated plants cannot always get enough microelements from the soil, therefore the importance of foliar fertilization increased. The timing is decisive for rapid and effective intervention to prevent yield loss or deterioration, and we can achieve yield increase and quality improvement as well. With the application of foliar fertilization we can increase the resistance of maize against the ecological stress factors, diseases and pests as well (HOFFMANN ET AL., 2004).
Considering the aspects of efficiency and environment protection, maize needs only $N_{60\text{-}120}$, $P_2O_{5\ 45\text{-}90}$, $K_2O_{53\text{-}106}$ kg ha^{-1} active agent. With N doses larger than $N_{60\text{-}120}$ kg ha^{-1} the quantity of NO_3-N reaches 150-200 mg kg^{-1} in the 100-120 cm soil profile which can result in marked environment pollution (SÁRVÁRI, 1995).
The foliar fertilization increased the yield, but it was not significant. With foliar fertilization the crude fat increased while the N-free extract decreased significantly. The results showed that there was no considerable difference in the energy contents of control and treated maize (JAKAB ET AL., 2014).
PEPÓ (2001) found that crop rotation strongly modified the optimum N doses (+PK) of maize. The optimum N doses were N_{113}+PK in triculture, N_{147}+PK in biculture and N_{187}+PK in monoculture. The efficiency of fertilization was modified by crop rotation and the water supply of the crop year. The yield surpluses resulting from fertilization were 1378 kg ha^{-1} in triculture (peas-winter wheat-maize), 2477 kg ha^{-1} in biculture (winter wheat-maize) and 2325 kg ha^{-1} in monoculture. There were hybrid-specific differences between the maize genotypes in optimum N doses (+PK) in the long-term experiments. In practice, the best hybrids are those that can produce high yields with the application of moderate (low) N doses (+PK).
KÁDÁR (2008) says that the macro and micro element requirements of most arable crops can be satisfied through soil. The future spread of foliar fertilisation must be grounded by

comprehensive experimental research. Accurate, repeated small plot trials are necessary to clarify the factors influencing the effectiveness of foliar fertilizers and recommendations must be developed for consultation.

The crop year had a great effect on the yield and generative factors of maize. The lack of rainfall during the tasselling can decrease the yield with large amount (FUTÓ AND SÁRVÁRI, 2015; DÓKA AND PEPÓ, 2009; KARANCSI, 2012).

The nitrogen supply had a great effect on the yield and generative factors of maize (GRANTHAM, 1997). The increasing nitrogen doses increased the amount of generative factor of maize and the yield as well (HEJAZI AND SOLEYMANI, 2014.

MATERIAL AND METHOD

Soil properties of the experimental field

We set the experiment on the area of Tangazdaság Ltd. in Hódmezővásárhely. The soil was meadow chernozem, the reaction of which was nearly neutral (pH_{KCL} 7.17). Before setting the experiment the soil analysis data showed that it had good nitrogen, and very good phosphor and potassium contents. The Zn content was low (*Table 1*).

Table 1. Main properties of the experimental field area

pH (KCl)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Humus (%)	Soil plasticity value (K_A)	Zn (mg/kg)
7.17	336	620	3.39	48	1.76

Weather in the experimental years

The year 2015 was unfavourable for maize production. In 2015 the amount of precipitation in the vegetative period of maize was lower by 83.4 mm than the average. The average temperature showed a positive deviation compared to the average of several years. The positive deviation of average temperature together with deficient precipitation had a negative effect on the development of corn, which resulted in low yields (*Table 2*).

Table 2. The distribution of precipitation in the vegetative period of corn in 2015

Month	Rainfall (mm)	Average rainfall (mm)	Difference (mm)
April	7.6	39.9	-32.3
May	75.5	58	17.5
June	12.2	75.3	-63.1
July	61.6	58.7	3.0
August	51.8	48.7	3.1
September	29.0	40.7	-11.7
Total amount of rainfall (mm)	**237.7**	**321.1**	**-83.4**

Main features of the agro-technology applied

Our small-scaled plough experiment was set in three replications, organised as a random block in 2013. We applied foliar fertilization treatments, which we supplemented with a control plot. The foliar fertilization was applied twice (31 May and 6 June) in a dosage of 1 l/ha. The fore-crop was maize. Fall tillage involved deep ploughing at 32 cm depth in the experimental years. The corn hybrid in the experiment was DKC 4025 (FAO 340). We harvested the plots by hand. We processed the obtained data by single factor variant analysis.

RESULTS

Without foliar fertilization the yield of the examined hybrid was 6.39 t/ha. With foliar fertilization the yield was 6.5-7.5 t/ha. Under the influence of foliar fertilization treatments the yield increased, but the increase compared to the control yield was not significant. We obtained the highest yield in the Amalgerol+Fitohorm Turbo Zn treatment (7.5 t/ha) and Fitohorm Turbo Zn treatment (7.35 t/ha) (*Figure 1*).

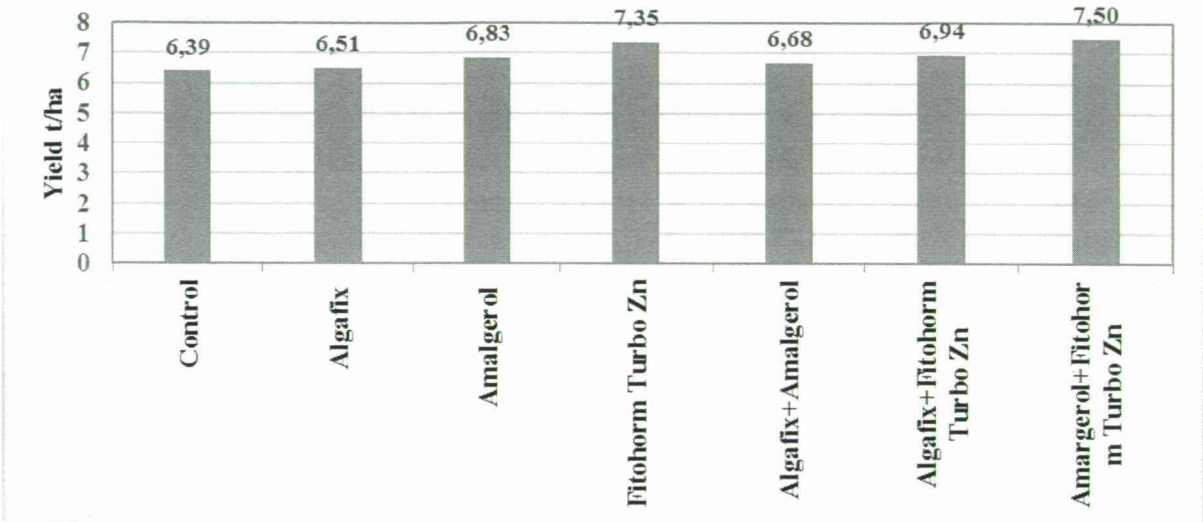

Figure 1. The yield of the maize hybrid in control and foliar fertilization treatment

We examined the effect of foliar fertilization on the generative factors of maize (thousand seed weight, cob:grain yield rates, seed moisture content). The thousand seed weight was 288.16 g in control treatment. Under the influence of foliar fertilizers the thousand seed weight ranged between 286.66 and312.33 g. The change was not significant. The values of cob:grain yield rates were 89.0-90.0%. The different treatment did not increase this parameter, because it is highly dependent on the genetical characteristics of hybrids. In 2015 the average temperature of July and August was higher, than the 50-year average, therefore the corn wilted earlier. The seed moisture content of control plots was the lowest 12.85%. In treated parcels we measured 13.36-14.38%. The difference wasn't significant between control and treated results (*Table 1.*).

Table 1. The result of foliar fertilizers on the different generative factors of corn

Treatments	Thousand seed weight (g)	Cob:grain yield rates	Seed moisture content at harvest (%)
Control	288.16	89.0	12.85
Algafix	312.33	90.0	14.38
Amalgerol	299.33	89.0	13.73
Fitohorm Turbo Zn	302.16	89.7	13.40
Algafix+Amalgerol	290.16	89.7	13.56
Algafix+Fitohorm Turbo Zn	286.66	89.0	13.64
Amalgerol+Fitohorm Turbo Zn	295.5	89.0	13.36
LSD5%	n.s.	n.s.	n.s.

CONCLUSIONS

The highest effect on the yield were the treatments which contained Zn (Algafix+Fitohorm Turbo Zn 6.94 t/ha, Fitohorm Turbo Zn 7.35 t/ha, Amalgerol+ Fitohorm Turbo Zn, 7.5 t/ha) which indicates that this area is a low Zn content in the soil to prevent the achievement of higher yields. The uptake of Zn also prevent soil phosphorus supply is very good because of antagonism between the two elements. The generative factors in terms of Algafix and Fitohorm Turbo Zn treatments were the best. Under the influence of foliar fertilizer treatment there were not significant differences in examined parameters. The use of zinc foliar fertilizer is recommended in this area in order to achieve higher yields and yield safety.

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ECONOMIC ASPECTS AND ENERGY PERFORMANCE OF THE COOLED POLYCRYSTALLINE SOLAR PHOTOVOLTAIC TECHNOLOGY

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ABSTRACT
In this paper the economic aspects of the water spraying cooling technology of polycrystalline solar modules with respect to the effect of temperature on performance was examined. The main purpose of this work was to explore the economic relations of the spraying cooling technology of solar modules.
In the study 5 kW PV system for residential customers, 5 kW and 50 kW PV system for business customer were studied.
In Hungarian climatic conditions, considering the inflation values used, the interest rate, the annual utilization of the cooling system, the expected profit and the maintenance costs show us that neither of the cooling solutions is capable of better payback time than the reference uncooled solar PV system.
The further research goal is to determine the usability of the cooling system in such countries which have on the one hand more ideal climatic conditions, on the other hand more predictable green energy feed regulations.

Keywords: solar energy, temperature-performance relation, water cooling

INTRODUCTION

The planning processes, the implementation and the increase in application methods of devices-systems that use renewable energy and contribute to energy savings have accelerated in recent years. In the latest period, we can see that the use of solar photovoltaic (PV) technology has also been characterized by rapid growth, mainly due to their reducing costs, rapid technological development and subsidies introduced in many countries, especially in Germany. The installation of smaller, household solar PV system of a few kW has become common, but the industrial-scale, MW photovoltaic solar power plants have also gained significant ground. Today the manufacturing costs and thus the consumer prices of the system components are decreasing, which result in the decline of investment payback time. According to Renewables 2015 GSR data, the total installed capacity of solar PV systems was 23 GW in 2009 and it expanded to 177 GW by 2014 (RENEWABLES, 2015; IEA, 2014; NÉMETH ET. AL., 2013).
Crystalline silicon PV technology is the most widespread among the solar modules on the market. These types are the most responsive to temperature rise, which negatively affects the production of electricity. For this reason, one of the easiest ways to improve performance is the cooling of solar modules (GREEN ET AL., 2015; IEA, 2014).
Several factors may influence the efficiency of the utilization of solar energy coming to the Earth. In the case of solar PV technologies the fluctuation of module temperatures due to the change of air temperature and global radiation is one of the important factors (SKOPLAKI AND PALYVOS, 2009; HAI ALAMI, 2014). Under Hungarian climatic conditions the temperature of solar PV modules can reach 60-70 °C on warm days, which results in a decrease of power generation in the module. For this problem various cooling technologies may offer solutions (CHANDRASEKAR ET AL., 2015).

In the case of crystalline silicon PV modules the efficiency characteristically decreases by 0.5% as a result of a 1 °C temperature rise, as it is shown in this research (RADZIEMSKA-KLUGMANN, 2002; CHANDRASEKAR ET AL., 2015; SKOPLAKI ET AL., 2009).
Four groups of cooling techniques can be distinguished (CHANDRASEKAR ET AL., 2015; JI ET AL., 2008): air-based, water-based, refrigerant-based, heat pipe-based.
In the present study the water-based (water spraying) procedures are discussed. There is a linear change in temperature-efficiency and thus in temperature-performance (SKOPLAKI AND PALYVOS, 2009). Changes in global radiation are closely related to changes in temperature. Under ideal, shadow-free conditions the performance of solar modules are decisively influenced by two factors, the global radiation and the temperature (SKOPLAKI AND PALYVOS, 2009).
In Hungary – like in many other EU countries – it is possible to feed solar power generated energy into the national electricity grid with the help of a domestic small PV system (for residential consumers, too) in addition to energy reception. It was conducted this examinations in the category of domestic small PV system both for residential and business customers, which is characterized by the fact that there is no guaranteed feed-in price of the energy generated (E.ON, 2016).

MATERIAL AND METHOD

Measurement site

In this work an active cooling method was examined that makes use of the cooling energy of evaporation. Based on economic considerations, was evaluated this results and compared them with those of uncooled polycrystalline solar module.
In the present experiment cooled (sprayed) and uncooled, ground-mounted and unused 50 W polycrystalline PV modules were examined under real meteorological circumstances, at the same measurement points, based on various experimental considerations in summer and autumn 2015.
During the experiments, solar modules were continuously measured using PicoLog data loggers. The automation of the cooling system was controlled by a thermostat, which was connected to the surface of the middle of the top third of the PV module. In order to save water the spray heads sprinkled the module intermittently, using exactly the amount of water needed to replace the water evaporated. (ZSIBORÁCS ET AL., 2015).
Apart from these the following technical-environmental parameters were determined:

- A Voltcraft VC607 professional multimeter, which was checked by an LT1021 device (10,000V +- 5mV), was used for the calibration of the voltage and the current,
- The humidity of the air was measured by a HYTE-ANA-1735 device,
- The global radiation was measured by a pyranometer (OMSZ-certified. Eppley Black and White Model 4-48),
- The wind speed was measured by a JL-FS2, 4-20 mA, 3-spoon aluminium device,
- For measuring the temperatures Pt 100 sensors were used (Zsiborács et al., 2016).

The electric signals from the measurements were transmitted to the PicoLog device. A True Maximum Point Seeking (TMPS) device, which maintained the maximum power point (MPP) was used for the measurements. The water needed for the PV module came from a domestic waterworks from a garden well with filtered underground water, after water softening.

The economic aspects of three different water reception solutions for cooling sprayed solar PV systems were examined, as:

- Cooling with rainwater
- Cooling with dug well
- Cooling with piped drinking water

The Expansion possibilities of PV systems in case of small scale domestic PV system

It was conducted this examinations on the cooling techniques of solar PV systems in case of roof-mounted, of domestic small PV systems (250W solar modules) of 5 kW and 50 kW rated power. In case of single-phase connection, 5 kW systems are the most favourable in terms of investment in Hungary (Zsiborács et al, 2014). In this case, a power inverter of up to 5 kW can be connected, even if the power available at the household would allow higher connection capacity. For the 50 kW system was considered the power available as given (E.ON, 2016).

The following case taking into account economic and technical parameters was examined:

- Installing a cooling system for the existing solar PV system

Characteristics required for energy production of solar PV systems in Hungary

In the course of this economic calculations, it was examined not only the investment needed for the solar PV system, but also the annual extra yield and financial expenditure (electricity, water, other equipment) of cooling technology under the current regulations in Hungary, in case of domestic small PV system available for residential and business customers on a yearly basis.

Annually 1.200 kWh-1.360 kWh per square metre energy comes from the Sun in Hungary, which is better than the European averages (800-2.000 kWh/sq m). In accordance with the data of Photovoltaic Geographical Information System (10 years real weather data) a grid-connected solar PV system of 1 kWp 1.280 kWh electricity is utilizable in Keszthely annually. It was calculated with 6% system loss and 35-degree angle in the study (PINTÉR ET AL., 2015; GLOBAL HORIZONTAL IRRADIATION IN HUNGARY, 2016; PHOTOVOLTAIC GEOGRAPHICAL INFORMATION SYSTEM, 2016).

Comparing the summer and the autumn measurements, there was no significant difference in the decrease in temperature due to spraying. Therefore, results obtained in summer measurements of greater item numbers in Hungary were suitable for analyzing the estimated period of operation of the cooling system. This is closely related to the fact that there is a linear relation in the changes of efficiency-temperature and thus in the changes of temperature-performance (RADZIEMSKA-KLUGMANN, 2002; CHANDRASEKAR ET AL., 2015).

To determine the ideal energy production periods, was used a solar PV system located in Siófok where production data (measured on a daily basis) and internet remote monitoring are available (thus the production data can be easily accessed hourly) (ZMET PV SYSTEM, 2015). For the determination of the usability of the cooling system has been used the following online programs:

- Photovoltaic Geographical Information System,
- PVWatts Calculator,
- WeatherSpark Weather Modeling System (Photovoltaic Geographical Information System, 2016; WeatherSpark, 2016; PVWatts Calculator, 2015).

It is advisable to use the cooling system if the daytime average temperature of the air is at least 20 °C. The daily electricity production curve of each solar plant is the same slope as of daily global radiation, since power generation is mainly determined by that.

From the analysis of the daily data of monthly production, was concluded the number of the "ideal days" of the given month, namely those days when the global radiation values were uninterrupted for the most part. It was examined the annual production data available and based on them was determined the average number of ideal days each month. From the number of ideal days determined was calculated the average returns of cooling technology over the next 15 years.

In Hungary, the period from May to September is appropriate for cooling. It was available data of one and a half years about the solar PV system in Siófok and four months from the location of the measurement (Keszthely). The distance between the two towns is 64.9 km. Thus, was estimated 70 ideal days (9 hours cooling time) in June, July and August, 18 days (8 hours cooling time) in May and 13 days (6 hours cooling time) in September, these data were used in economic calculations for the next 15 years.

There was determined an annual performance degradation characteristic of crystalline solar module as 0.5%, which value can be considered generally accepted (DIRK ET AL., 2012). It has been examined a 15-year time period as the operating period, since a grid-connected solar PV system should be checked every 15 years. Maintenance work should be carried out after this period, replacing the inverter is also due after approximately 15 years. Ideally, there are no maintenance costs of the system for 15 years. On the other hand, in case of cooled systems was assumed that water filters are replaced every year. The latter is more favourable for businesses customers and 50 kW systems, because discounts are enforceable. Due to low utilization time and / or operating time, it is not necessary to repair / replace the pump. Maintenance costs were deducted together with cost savings (ALLENBACH HOLZBAU UND SOLARTECHNIK AG, 2014, PINTÉR ET AL., 2014). It was determined the current interest rate needed for the determination of the time value of dynamic economic indicators at 3.88% in accordance with the 15/01/2016 status of 15-year term Hungarian bond yields. It has been determined the annual change in the price of electricity and piped water at 1.79% in accordance with the inflation data of the period 2012-2015. Inflation is important because of the changes in feed-in tariffs, while government bond yields are needed for future income expectations (HUNGARIAN REFERENCE YIELDS, 2016; HUNGARIAN 15-YEAR TERM BOND YIELDS DATA, 2016; HUNGARY – INFLATION RATE 2016).

In case of residential customers was calculated with gross values, while in case of businesses customers with net values. In case of electricity prices for residential customers it is a gross price of 35.33 HUF / kWh, while for businesses customers a net price of 38.23 HUF / kWh in the first year of our calculation (E.ON, 2016).

Cooling with rainwater

As for cooling with rainwater, it was assumed the following. Rainwater is collected into storage tanks from the top of the building (with gutters) and there is always enough rainwater in the storage tank. At a 5 kW system 6 black IBC containers are required to be used. Black colour is important for the protection against algae. It was also assumed the use of chlorine-free, anti-algae disinfectant. Rainwater does not contain scale, thus it is not necessary to protect against that, but it is advisable to filter out contaminants from the collected rainwater.

Cooling with dug well

In case of cooling solar PV systems with wells, the question arises whether a dug or a drilled well is more suitable. There is no clear answer, since it mostly depends on the conditions of the area in terms of water management. If the ground water is relatively high and it constantly recovers, we should choose a dug well, if this is not the case, it is

reasonable to use a drilled well. In accordance with point (1) c of section 24 of 72/1996 (V. 22.) Governmental Regulation on the Implementation of Government Jurisdiction on Water Resources, a licence from the notary of the local government is needed for the creation, use or termination of a dug or drilled well which serves to meet the domestic water needs of the constitutor up to 500 cubic metres per year and which works using groundwater only without making use of bank-filtered water and karst and aquifer water resources (REGULATION ON DUG AND DRILLED WELLS, 2015). In this case, it was calculated with using a dug well. This solution requires protection against scale, since from the evaporating water scale is deposited on the surface of the polycrystalline module. This problem should be treated with reverse osmosis water filter. Pressure required for spray-nozzles would be provided by an expansion vessel containing filtered water – mounted next to the water purifier – and an industrial solenoid valve. In case of reverse osmosis water filters, the annual replacement of filters must be taken into account.

In case of present calculations two assumptions were used:

- 1 there is no well available
- 2 there is a well available

Cooling with piped water

In case of piped water was calculated with using tap water for watering purposes, for this reason technical equipment requiring significant investment can be omitted – unlike in case of previous solutions – e.g. domestic water works and water storage tanks. Furthermore, there is no need for the establishment of a dug well.

In case of this solution, it is also necessary to protect against scale with the help of reverse osmosis water filter. In this case as well, pressure required for spray-nozzles would be provided by an expansion vessel containing filtered water – mounted next to the water purifier – and an industrial solenoid valve. In case of piped water, a separated water meter for watering must be installed, the plan of which must be approved (DRV, 2015).

Pressure required for spray-nozzles would be provided by an expansion vessel containing filtered water – mounted next to the water purifier – and an industrial solenoid valve.

RESULTS

Features of the system

In case of the 50 W polycrystalline solar module used for the experiments 3 litres of water was sprayed during the measurement period of approximately ~9 hours, 2.9 litres in case of eight-hour operation, while 2.3 litres of water is expected to be used in case of six-hour operation.

Twenty 250 W polycrystalline solar modules are used for a solar PV system of 5 kW nominal output selected for the economic evaluation. In case of one module, six spray-nozzles can ensure adequate sprayed surface.

The achievable daily energy production

When comparing data, it was assumed the water control settings of the cooled polycrystalline solar modules and the average decrease in temperature in the given period in Keszthely. For the systematic evaluation of the excess capacity values experienced was used the solar PV system in Siófok, that way the average daily excess energy yields were determined (with the help of three days of each ideal month).

If considering the ideal days in terms of radiation annually and the energy required to operate the pump when calculating the daily excess production, the actual annual energy gain is 2.2% in Hungary (Keszthely and Siófok). As for the economic analysis of the cooling technology of solar modules was determined investment efficiency ratios of 5 and 50 kW systems as reference, since the cooling system would be installed with these in mind. In Hungarian climatic conditions, considering the inflation values used, the interest rate, the annual utilization of the cooling system, the expected profit and the maintenance costs show us that neither of the cooling solutions is capable of better payback time than the reference uncooled solar power plant (*Table 1*).

Table 1. Summary data of different cooling solutions

In Case of residential customers, 5 kW					
Denomination	**Reference uncooled**	**Existing dug well**	**Using piped water**	**Installing dug well**	**Using rainwater**
Useful life, year	15				
Interest rate considered[1] (r) [%]	3.88				
Inflation rate considered[2] (r) [%]	1.79				
Investment costs[3] [thousand HUF]	2 247	2 532	2 530	2 880	2 644
Maintenance costs at constant prices [thousand HUF]	0	300	383	300	150
Net present value (NPV) [thousand HUF]	514	74	6	-283	65
Profitability index (PI)	1.23	1.03	1.00	0.90	1.02
Discounted payback period (year)	12.2	14.6	15	16.6	14.6
In case of businesses customers, 5 kW					
Investment costs[2] [thousand HUF]	1 770	1 986	1 992	2 268	2 082
Maintenance costs at constant prices [thousand HUF]	0	216	290	216	109
Net present value (NPV) [thousand HUF]	1 218	903	844	621	889
Profitability index (PI)	1.69	1.45	1.42	1.27	1.43
Discounted payback period (year)	8.9	10.3	10.5	11.8	10.5
In case of businesses use customers, 50 kW					
Investment costs[2] [thousand HUF]	17 500	18 718	18 912	19 033	19 573
Maintenance costs at constant prices [thousand HUF]	0	2 100	2 900	2 100	1 050
Net present value (NPV) [thousand HUF]	12	10	9	9	10
Profitability index (PI)	1.71	1.55	1.50	1.52	1.52
Discounted payback period (year)	8.8	9.7	10	9.9	9.9

[1] investing.com, 15/01/2016
[2] Trading Economics, 2016
[3] EGH KFT, 2016

Source: Own work of the authors

Cooling with an existing dug well

A summary of the findings of the systems are shown in *Table 1*. From the spraying methods, the shortest payback period – 14.6 years for residential customers, 10.3 and 9.7 years for business customers – can be achieved in case of existing wells. In this case, there

are no costs involved in digging a well, only in installing the cooling solution necessary for spraying (*Table 1*).

CONCLUSIONS

It was carried out a technical and economical comparative study of 50 W polycrystalline solar modules of the same type and capacity, both uncooled and cooled, with the same solutions and the same measurement point, under outdoor, real weather conditions in summer and autumn, 2015.

Resulting from the ideal periods in Hungary, the annual extra yield of the cooling system tested is 2.2%. In Hungarian climatic conditions, considering the inflation values used, the interest rate, the annual utilization of the cooling system, the expected profit and the maintenance costs show us that neither of the cooling solutions is capable of better payback time than the reference uncooled solar power plant. However, cooling with the help of an existing dug well is still viable, as well as the new solar PV system, however if ranked, it does not come before the latter. At the same time, cooling with the help of an existing well offers a real alternative to increase the performance of a solar power plant with maximum space utilization (which cannot be expanded further due to lack of space), since this investment has a positive net present value.

The further research goal is to determine the usability of the cooling system in such countries which have on the one hand more ideal climatic conditions, on the other hand more predictable green energy feed regulations.

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FACTOR ANALYSES FOR ECONOMIC GROWTH IN EU-28 AND MENA-4 COUNTRIES

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ABSTRACT
This study uses eight main different statistical fields, as components between 2005-2014. The following step of the research is that the factor analyses, when in case of the first FACT1 three variances of the first component are, namely GDPVol2014, UnEmploy2014 and RisPov2014 are compared with two variances of the second component, namely GovDebt2014 and SocProt2014. In the second FACT2 analyse three variances of the first component, namely GDPVol2014, UnEmploy2014 and RisPov2014 are compared with two variances of the third component, namely LLearn2014 and GDPcap2014. The cluster analyse system separates the EU-28 member states and shows how these countries are closed by their special performance.
The biggest group includes 22 member states closed to each other in field of their economic performance. The biggest country group originally also can be separated into 10 smaller country-group. The second country-group was consisting of two member states, namely France and Portugal, which countries were connected by mostly similarly economic growth rate with different economic developed levels. The third country–group included Spain, Cyprus, Greece and Ireland, where the low economic growth and low level of GDP volume growth were closed in case of Spain and Cyprus, but in Greece the unemployment rate was so highly and Ireland realised highly strong GovDebt2014 and SocProt2014 in its economic performance with low level for GDPVol2014 and GDPcap2014. The factor analyses and dendrogram system can show the clear selection methods for the economies, which help the researchers and policy makers to create the economic policy strategy and financial support for those countries which have the biggest backwardness in their economic development.

Keywords: variances, cluster analyses, correlation, country-groups, dendrogram

INTRODUCTION

This study uses eight main different statistical fields, as components between 2005-2014: namely Total unemployment rate in % (UnEmploy2014); GDP and main components – volumes (GDPVol2014); HICP - inflation rate (HICP: Harmonised index of consumer prices, HICPan2014); General government gross debt (GovDebt2014); Expenditure on social protection (SocProt2014); Lifelong learning in %, Total (LLearn2014)); People at risk of poverty or social exclusion by age and sex (RiskPov2014); Real GDP per capita, growth rate and totals (GDPCap2014).

MATERIAL AND METHOD

Factor analyses

The following step of the research is that the factor analyses, when in case of the first FACT1 three variances of the first component are, namely GDPVol2014, UnEmploy2014 and RisPov2014 are compared with two variances of the second component, namely

GovDebt2014 and SocProt2014. In the second FACT2 analyse three variances of the first component, namely GDPVol2014, UnEmploy2014 and RisPov2014 are compared with two variances of the third component, namely LLearn2014 and GDPcap2014. Those countries from EU-28 are under "X" line and PLUS side, the GDPVol2014 is at high level, and the RisPov2014 and UnEmploy2014 are at low level (See more detailed in SAJTOS ET AL, 2007; structure of SPSS in applied study for Czech Republic in SZÉLES, ET AL, 2010; factor analyses concern the controlling system and financial issues, in ZÉMAN ET AL, 2014).

RESULTS

FACT1 ("X") and FACT2 ("Y") analyses

The first FACT1 analysis can be seen in the *Figure 1*: Factor-1 and Factor-2 analysis for EU-28. In the *Figure 1* the average value of the two, First and Second principle components is equal with zero, 0. The "X" and "Y" lines are the reference lines, which are average values of the countries, as EU-28 member states. In the "X" line concerning the FACT1 including three variances, namely GDPVol2014, UnEmploy2014 and RisPov2014, from the "0" to the right side is PLUS and from the left side is MINUS. From these approach the -0,907 value of GDPVol2014 is in this MINUS left side of "X" line. In case of those countries, which are under the "X" line in MINUS sector - they have high increase level of GDPVol2014, and because the value of Unemploy2014 and RisPov2014 are plus, therefore these countries have low level in RisPov2014 and UnEmploy2014 in this same sector (also see the *Figure 1* and the *Table 1*).

In the "Y" line concerning the FACT2 including two variances, namely GovDebt2014 and SocProt2014, from the "0" to the upper side is PLUS and from the down side is MINUS. From this approach the 0,902 value of GovDebt2014 and 0,800 value of SocProt2014 are in this PLUS upper side of "Y" line. In Left-Upper-Side Sector in case of those countries, which are upper side of "Y" line in PLUS sector - they have high increase level of GovDebt2014 and SocProt2014. Also from the earlier analysed conditions the GDPvol2014 is also high. But the UnEmploy2014 and the RiskPov2014 are at low level.

In the Left-Down-Side Sector the GovDebt2014 and the SocProt2014 are at low level, the GDPVol2014 is high, the UnEmploy2014 is low, because of the consequence of high GDPVol2014, also the RisPov2014 is low.
In the Right-Down Side Sector the GDPVol2014 is at low level and the UnEmploy2014 and RiskPov2014 are at highly level. But the GovDebt2014 and SocProt2014 are at low level.
In the Right-Up-Side Sector the GDPVol2014 is at low level and the UnEmploy2014 and RiskPov2014 are at high level. The GovDebt2014 and SocProt2014 are also at high level.

FACT1 ("X") and FACT3 ("Y") Analyses

Starting from the first FACT1 analyses can be seen in the *Figure 2:* Factor-1 and Factor-3 Analysis for EU-28. In the *Figure 2* also the average value of the two, First and Second principle components is equal with zero, 0. The "X" and "Y" lines are the reference lines, which are average values of the countries, as EU-28 member states. In the "X" line concerning the FACT1 including three variances, namely GDPVol2014, UnEmploy2014 and RisPov2014, from the "0" to the right side is PLUS and from the left side is MINUS.

In the "Y" line concerning the FACT3 including two variances, namely LLearn2014 and GDPcap2014, from the "0" to the upper side is PLUS and from the down side is MINUS. From these approach the 0,779 value of LLearn2014 and 0,737 value of GDPcap2014 are in this PLUS upper side of "Y" line.

In Left-Upper-Side Sector in case of those countries, which are upper side of "Y" line in PLUS sector - they have high increase level of LLearn2014 and GDPcap2014. Also from the earlier analysed conditions the GDPvol2014 is also at high level. But the UnEmploy2014 and the RiskPov2014 are at low level.

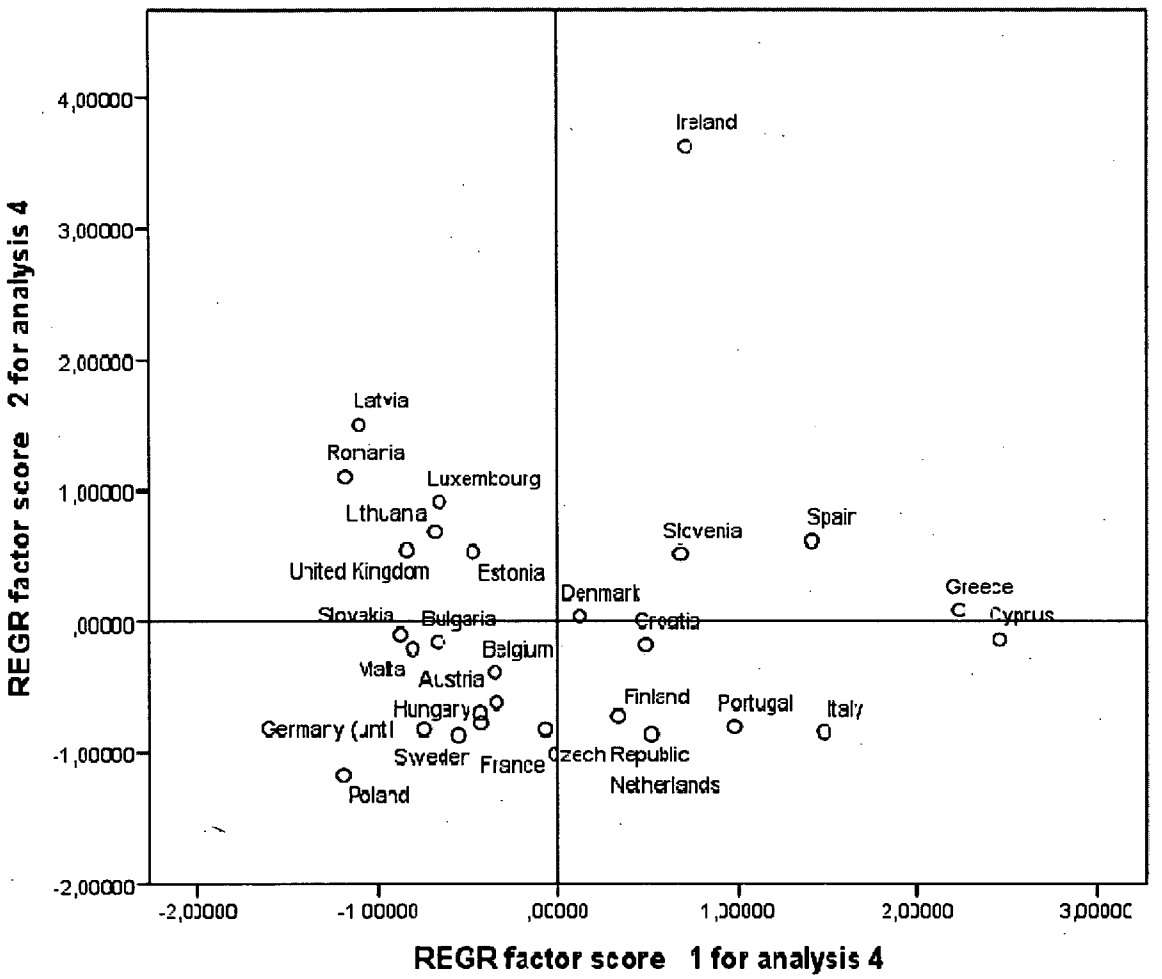
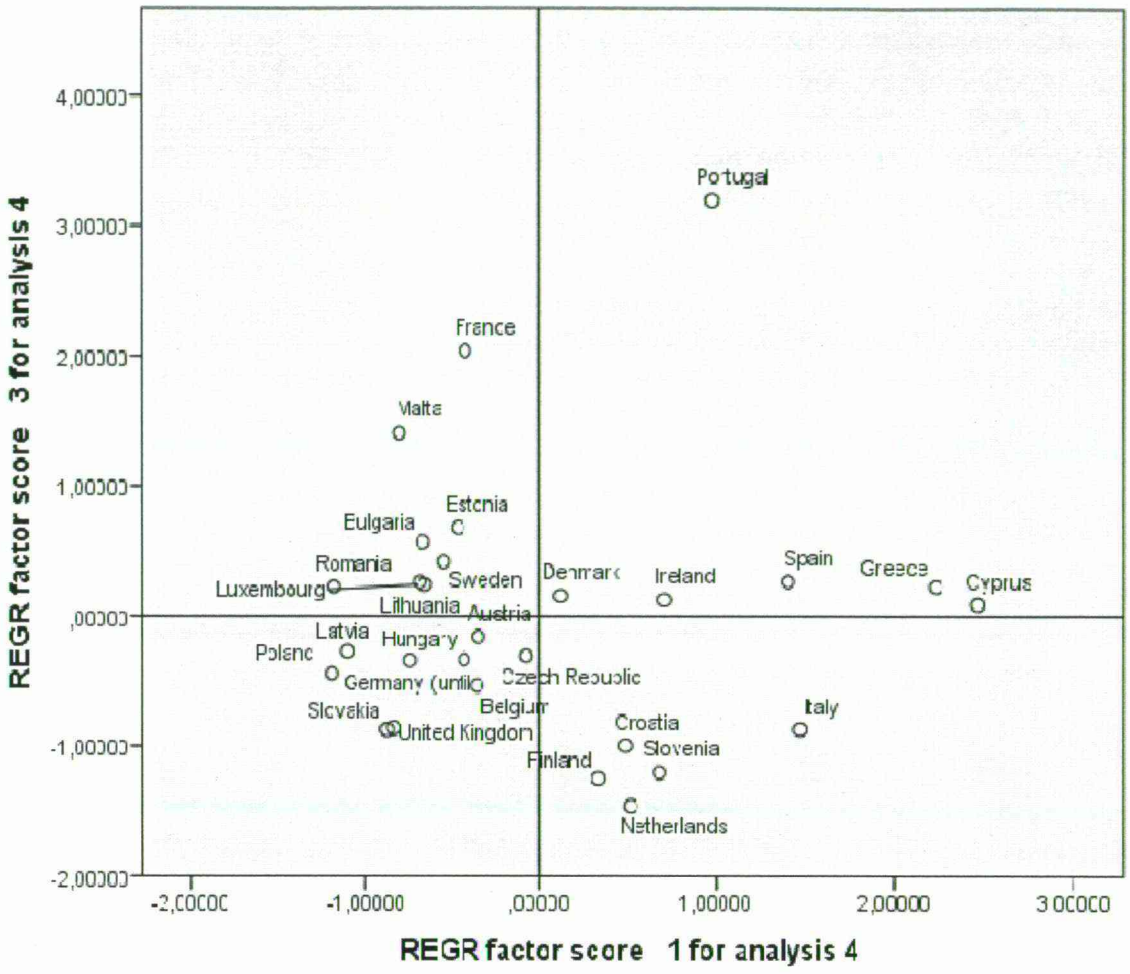


Figure 1. Factor-1 ("X") and Factor-2 ("Y") Analysis for EU-28

* Chart Builder.

Table 1. Case Processing Summary[a] for Figure 1

Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
28	100,0%	0	0,0%	28	100,0%



DATASET DECLARE D0.7638405787722926.

Figure 2. Factor-1 ("X") and Factor-3 ("Y") Analysis for EU-28

In the Left-Down-Side Sector the GovDebt2014 and the SocProt2014 are at low level, the GDPVol2014 is high, the UnEmploy2014 is low, because of the consequence of high GDPVol2014, also the RisPov2014 is low. But the LLearn2014 and GDPcap2014 are at low level.
In the Right-Down Side Sector the GDPVol2014 is at low level and the UnEmploy2014 and RiskPov2014 are at high level. But the GovDebt2014 and SocProt2014 are at low level. But the LLearn2014 and GDPcap2014 are at low level.

In the Right-Up-Side Sector the GDPVol2014 is at low level and the UnEmploy2014 and RiskPov2014 are at high level. But the GovDebt2014 and SocProt2014 are at high level. Also the LLearn2014 and GDPcap2014 are at highly level.

Cluster Analyses for EU-28

The cluster analyses show the separation of the EU-28 member states based on their economic capacity and growing rate according to the eight variances within three principle components and factor analyses, how three components are within two compares the

FACT1 with FACT2 and FACT1 with FACT3. The cluster analysis system separates the EU-28 member states and shows how these countries are closed by their special performance. Those EU member states can be selected in a group, which have the smallest distance from each other. From point of view of the Dendrogram for EU-28 shows very clearly the structure system for the different groups of the EU-28 member states. Based on the data base Agglomeration Schedule for EU-28, the dendrogram structure can be cut between 10 and 15 value of the Dendrogram, by which three main country-groups can be created (see *Figure 3*).

The biggest group includes 22 member states closed to each other in field of their economic performance. The biggest country group originally also can be separated into 10 smaller country-group. The explain is for the large number of the biggest country group within EU-28 is that the economic grow rate of this EU-member state group closed to different developed EU member states. The highly developed economies have decreasing grow rate and less developed economies have higher grow rate for their GDP volume and GDP per capita. Two contradicting growing rates within this group of 22 EU-member states became closed to each other. Therefore for example Germany, Belgium, Austria, Hungary, Sweden, Denmark, United Kingdom, Netherlands and Italy with Bulgaria, Romania, Poland, Croatia and Lithuania became members of this country group. Naturally the last world economic recession started in 2008 made a large brake for the economic growth of the EU-member states, but this was for a shorter period than in case of developing countries.

The second country-group was consisting of two member states, namely France and Portugal, which countries were connected by mostly similarly economic grow rate with different levels of economic development.

The third country–group included Spain, Cyprus, Greece and Ireland, where the low economic growth and low level of GDP volume growth were closed in case of Spain and Cyprus, but in Greece the unemployment rate was so high and Ireland realised highly strong GovDebt2014 and SocProt2014 in its economic performance with low level for GDPVol2014 and GDPcap2014, in spite of the financial support given by the EU per capita for Ireland has been the highest level for several years in 2010s. The GovDebt2014 and SocProt2014 of Ireland could be kept at high level, because of high level of social protection, like pension system and health care were strengthened by EU support.

The Squared Euclidean Distance for EU-28 shows the distance among the EU member states in fields of economic growth rate, namely GDPVol2014 and GDPcap2014 also with other variances of the factor analyses. The largest distance is between Ireland from Poland by 71,260; from France by 54,691; from Hungary by 52,408 and from Germany by 54,314. Also the distance is very large between grow rate level of Ireland, Greece and Spain of the third country group and the grow rate level of the other EU-member states.

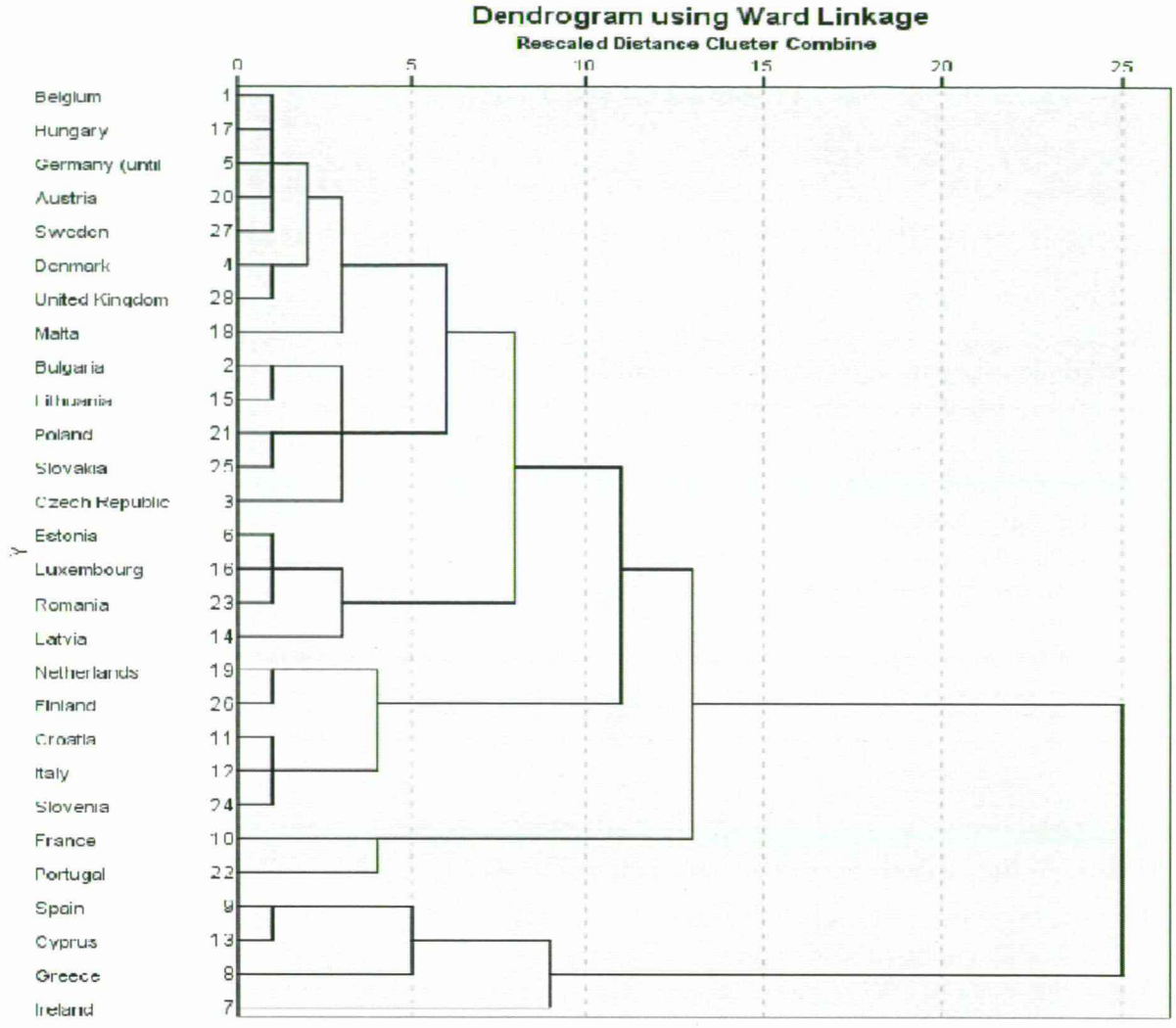


Figure-3. Dendrogram for EU-28

CONCLUSIONS

The factor analyses and dendrogram system can show the clear selection methods for the economies, which help the researchers and policy makers to create the economic policy strategy and financial support for those countries which have the biggest backwardness in their economic development. Also the economic development of countries needs for wide side cooperation among countries of each international economic integration, as EU-28.

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